Aviation Week

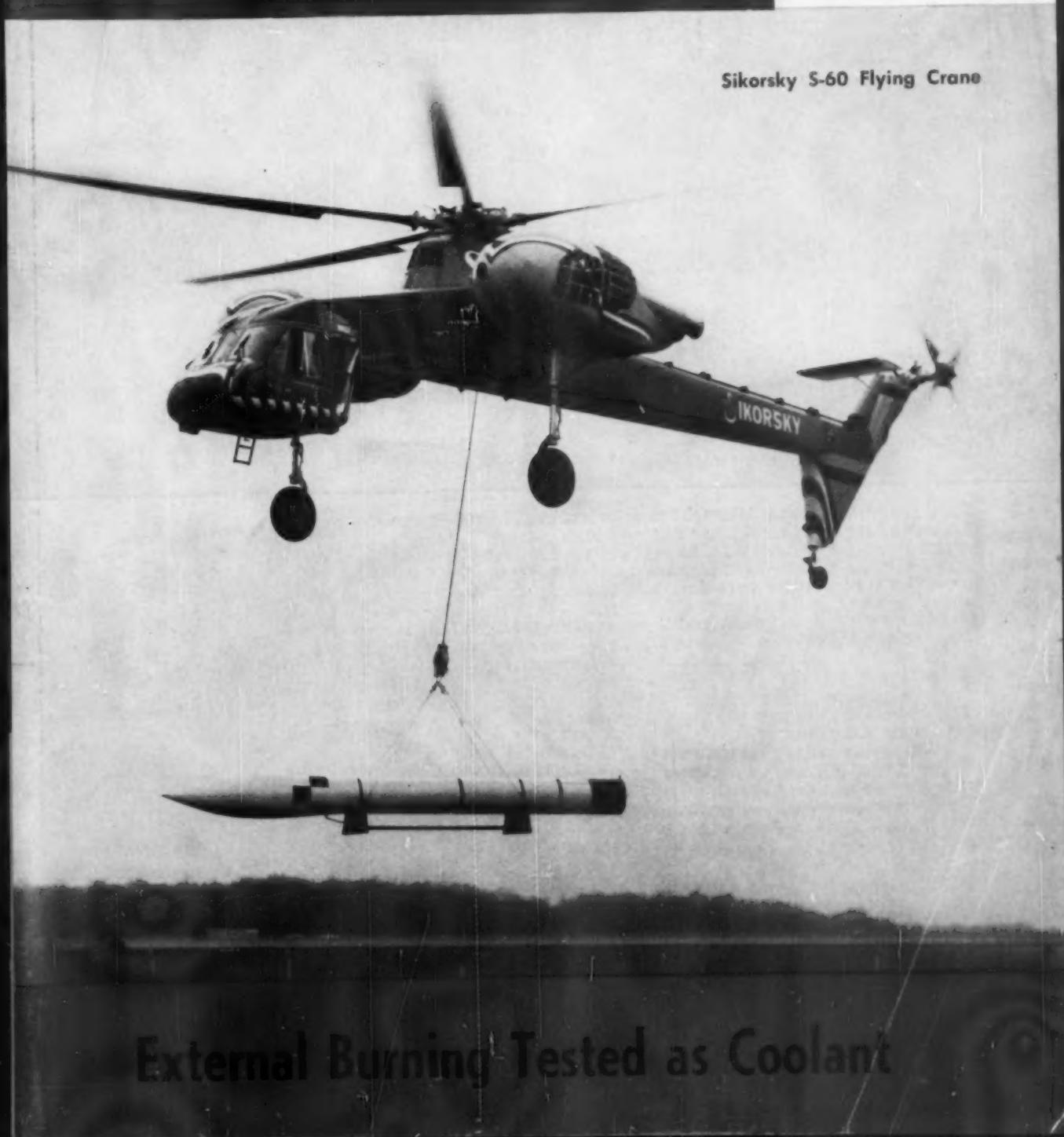
Including Space Technology

A McGraw-Hill Publication

75 Cents

April 20, 1959

Chance Vought Simulates Orbit, Hypersonic Glide



Sikorsky S-60 Flying Crane

External Burning Tested as Coolant

A FORCE TO RECKON WITH

RHEEM ORDNANCE!

Test of a warhead developed by Rheem that utilizes a new principle in the state of the art of warhead design. Rheem development is fully supported by test sites, chemical laboratory, ballistics tunnel, and a separate Explosives Loading Facility.

For the past two decades and through two major conflicts, Rheem Ordnance has been *a force to reckon with*. As a major ordnance contractor for our Armed Forces, Rheem produced millions of shells and made significant contributions to ordnance technology in the design, development, and production of fuzes, rockets, practice bombs, land and underwater mines, and other conventional armament.

Today, all branches of the Armed Forces continue to look to Rheem for leadership in Explosive Ordnance, Missile Warheads and Fuzes, and Basic Research. A partial list of current projects underway at Rheem includes:

MINES, GRENADES, PRACTICE BOMBS
NON-NUCLEAR WARHEADS
WARHEAD ADAPTION KITS
FUZES AND SAFETY AND ARMING DEVICES
EXPLOSIVELY ACTUATED VALVES, SWITCHES, SEPARATION DEVICES
EXPLOSIVE FORMING OF METALS
EXPLOSIVE RESEARCH AND HYPERVELOCITY IMPACT
RELIABILITY AND LETHALITY STUDIES

Rheem Ordnance makes many products that it hopes will never be used. But the ultimate in reliability is carefully engineered into every Rheem product, so that, should an aggressor strike, America's defenses will not be found lacking.

For more complete information on Rheem Ordnance capability, write to Dept. AW-707-1

Newly developed fuze for Nike Hercules warhead—designed, tested and produced by Rheem

BDU-4/B: one of a family of full-scale practice bombs developed for the Air Force by Rheem

Advanced warhead for Nike Hercules: developed, tested and produced by Rheem

RHEEM MANUFACTURING COMPANY

Defense and Technical Products Division

11711 woodruff avenue, downey, california

Rheem

ORDNANCE • PROPULSION & MISSILE SYSTEMS • PRESSURE VESSELS • DRONES • ELECTRONICS • RESEARCH

High temperature hydraulics

In 1943 Hydro-Aire built its first hydraulic valve. More than 100,000 valves and controls have since followed this initial contribution to airborne hydraulic systems. Put them all together and they could well handle the output of an active volcano.

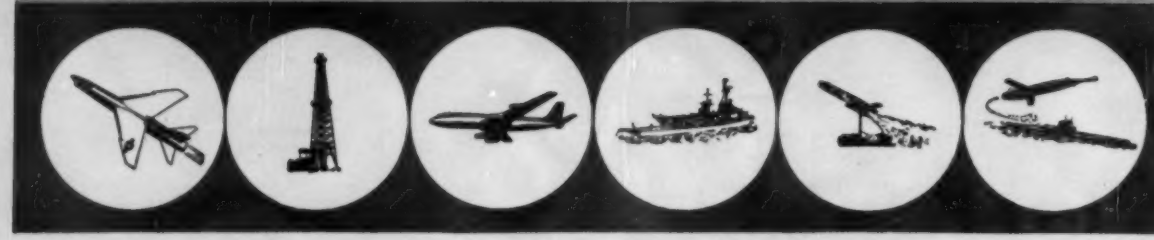
Today's requirements for high temperature, high flow and high pressure hydraulic controls call for new ingenuity and new capabilities. To meet this demand, Hydro-Aire has combined its experience in high temperature pneumatic controls and high flow fuel system controls with its considerable experience in hydraulics. The result: a unique combination of capabilities and manufacturing know-how to meet the need for complex miniaturized hydraulic controls that will function with fluid temperatures of 450°F, 700°F ambient temperature, and under pressures in the 4,000-5,000 PSI range.

HYDRO-AIRE
BURBANK, CALIFORNIA
Division of CRANE CO.
Anti-Skid Braking Systems • Fuel System Controls • Pneumatic Controls • Hydraulic Controls Actuation Systems • Electronic Devices

Producing Controls for Every Basic Airborne System

SARGENT

SERVO-SYSTEMS OF FORCE CONTROL



With 38 years acceptance Sargent builds precision linear and rotary hydraulic, pneumatic, mechanical and electronic systems of force control to meet successfully the increasingly high requirements of marine, aircraft, missile, petroleum and industrial use. From original idea to finished product – SARGENT.

SARGENT FACILITIES	Manufacturing Including –
Research	Machining & Grinding
Design	Heat Treating, all types
Development	Plating, all types
Testing	Inspection
Qualifying	Assembly

SARGENT BUILDS	
Servo-Systems	Hydraulic Pumps
Hydraulic Systems	Hydraulic Motors
Integrated Packages	Pneumatic Cylinders
Hydraulic Actuators	Pneumatic Valves
Hydraulic Valves	Ball Screw Actuators
	Gear Actuators
	Gear Accessory Boxes
	Electronic Systems

Standard of Excellence — *Since 1920*

Sargent — QUALITY BUILDS GOOD WILL

ENGINEERING CORPORATION

MAIN OFFICE & PLANT, 2533 E. FIFTY-SIXTH ST.
HUNTINGTON PARK, CALIF.

"GOOD WILL" is the disposition of the pleased customer to return to the place where he has been well treated.
– U.S. Supreme Court

AVIATION CALENDAR

Apr. 27-29—13th Annual Meeting, Aero Medical Assn., Statler Hilton Hotel, Los Angeles, Calif.

Apr. 29-May 1—First National Metals Engineering Conference, American Society of Mechanical Engineers, Hotel Sheraton-Ten Eyck, Albany, N. Y.

Apr. 30-May 1—Controllable Satellites Conference, American Rocket Society, Massachusetts Institute of Technology, Cambridge, Mass.

Apr. 30-May 1—Second Annual Meeting Aircraft Electronics Assn., McAllister Hotel, Miami, Fla.

May 3-7—Symposium on Electrode Processes, Phila., Pa. Sponsors: AFOSR/Chemistry Division and Electromechanical Society. (Contact Electrochemical Society, Inc., 1860 Broadway, N.Y.C.)

May 4-6—National Aeronautical Electronic Conference, Institute of Radio Engineers, Biltmore Hotel, Dayton, Ohio.

May 4-7—Fifth Annual Flight Test Instrumentation Symposium, sponsored by the Instrument Society of America, Seattle Section, Olympic Hotel, Seattle, Wash.

May 4-7—American Meteorological Society's 176th National Meeting, held jointly with the American Geophysical Union, National Academy of Sciences, Washington, D. C.

May 5-7—Joint Meeting, International Scientific Radio Union and Institute of Radio Engineers, Willard Hotel, Washington, D. C.

May 5-7—Annual Meeting, California Assn. of Airport Executives, Casa Munros Hotel, Monterey, Calif.

May 6-8—1959 Electronic Components Conference, Benjamin Franklin Hotel, Philadelphia, Pa.

May 6-9—15th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

May 7-10—Annual Meeting, National Inter-

(Continued on page 6)

AVIATION WEEK Including Space Technology

April 20, 1959

Vol. 70, No. 16

Published weekly with an additional issue in December by McGraw-Hill Publishing Company. James H. McGraw (1860-1948), Founder. See panel below for directions regarding subscription or change of address. Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y. Publication Office, 99-129 North Broadway, Albany 1, N. Y. Donald C. McGraw, President; Joseph A. Gerardi, Executive Vice President; L. Keith Goodrich, Vice President and Treasurer; John J. Cooke, Secretary. Officers of the Publications Division: Nelson L. Bond, President; Harry L. Waddell, Senior Vice President; Ralph B. Smith, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator.

Subscriptions are solicited only from persons who have a commercial or professional interest in aviation, including missiles and space technology. Position and company connection must be indicated on subscription order.

Single copies 75¢. Subscription rates—United States and possessions, $7 one year. Canada $8 one year. All other countries, $20 one year.

Second class postage paid at Albany 1, N. Y. Printed in U. S. A. Title registered in U. S. Patent Office.
©Copyright 1959 by McGraw-Hill Publishing Co., Inc. All rights reserved. Cable Address: "McGraw-Hill New York." Publications combined with AVIATION WEEK, including SPACE TECHNOLOGY are AVIATION, AVIATION NEWS, AIR TRANSPORT, AERONAUTICAL ENGINEERING and AIRCRAFT JOURNAL. All rights to these names are reserved by McGraw-Hill Publishing Co.

Subscribers: Send correspondence and change of address to Fulfillment Manager, Aviation Week, 330 West 42nd Street, New York 36, N. Y. Subscribers should notify Fulfillment Manager promptly of any change of address, giving old as well as new address, including postal zone number. Enclose recent address label if possible. Allow one month for change to become effective.

Postmaster: Please send form 3579 to Aviation Week, including Space Technology, 330 West 42nd Street, New York 36, N. Y.

TRANS-SONICS T.M.

QUARTECTOR*

LIQUID LEVEL DETECTION SYSTEMS

for liquid oxygen and rocket fuels

- **No moving parts assure unsurpassed reliability**
- **Will not respond to wetting or splashing**

IN-TANK SENSOR

ELECTRONIC UNIT

Explosion-proof version for ground installation

IN-LINE PROBE

Quartector Liquid Level Detection Systems, with no moving parts to stick or freeze, detect liquid levels to within ± 1/32" with a response time of less than 40 milliseconds. Operating temperature range is from −425°F to +120°F.

Quartector systems and instruments are designed for *bulk liquid applications* such as fuel tanks in missiles or other types of pressure vessels, and for *pumping applications*. A real-time indication is provided when the liquid has reached pre-selected points in pipe lines or tanks.

The Quartector sensing element is a piezo-electric quartz crystal mounted in a probe or submersible sensor unit. Circuitry consists of a four stage transistor amplifier with a transistor detector circuit in the feedback loop, and an output control relay. When the crystal is in gas, it is free to vibrate at its natural frequency, and oscillation is sustained. When the crystal is submersed in liquid, however, its motion is damped, signal output drops, and the output control relay is de-energized.

Splashing, bubbles, and wetting do not affect the sensor. Liquid indication is given only when the crystal is completely surrounded by liquid. Safety features include a fail-safe and function test procedure. Write to Trans-Sonics, Inc., Dept. 7, Burlington, Massachusetts, for Technical Bulletin 1900.

TRANS-SONICS

Precision Transducers

*TRADEMARK

HADLEY

missile valves & controls

Temperature problems?

Guess everybody in the business has temperature problems, and only experience can solve them. In addition to our altitude, vibration and other environmental equipment, Hadley laboratories are equipped for high and low temperature testing. Why not share your problems with us? Hadley designers, supported by precision manufacturing and rigid quality control have been able to design, develop and deliver the quality product on schedule.

For more information write,
J. T. Reilly, Director of Marketing.

Pioneers in Cryogenic Valves

• **ENGINEERS: Inquire about attractive project & design career opportunities.**

B. H. HADLEY INC.*

POMONA, CALIFORNIA

*Wholly owned subsidiary of Central Hadley Corporation — listed American Stock Exchange.

AVIATION CALENDAR

(*Continued from page 5*)

collegiate Flying Assn., University of Illinois' Airport, Champaign, Ill.

May 9—Federal Aviation Agency's "fly-in" for pilots and aircraft owners, National Aviation Facilities Experimental Center, Atlantic City, N. J.

May 15-16—Spring Meeting, Society of Aircraft Materials and Process Engineers—Eastern Division, Hotel Statler, New York, N. Y.

May 18—Symposium on Space Medicine Electronics, Franklin Institute, Philadelphia, Pa.

May 18-21—18th Annual National Conference, Society of Aeronautical Weight Engineers, Hotel Henry Grady, Atlanta, Ga.

May 20-22—National Spring Meeting & Exhibition, Society for Experimental Stress Analysis, Sheraton Park Hotel, Washington, D. C.

May 20-22—Second Jet Age Airport Conference, American Society of Civil Engineers, Shamrock-Hilton Hotel, Houston, Tex.

May 21-22—1959 Ohio Valley Instrument and Automation Exhibit and Symposium, Cincinnati Section, Instrument Society of America, Music Hall, Cincinnati, Ohio.

May 24-June 5—Federation Aeronautique Internationale Annual Meeting, Moscow, USSR.

May 25-27—1959 National Telemetering Conference on Investigation of Space, Brown Palace and Cosmopolitan Hotel, Denver, Colo. Sponsors: American Rocket Society, Institute of the Aeronautical Sciences, American Institute of Electrical Engineers and Instrument Society of America.

May 25-27—All Industry Production and Quality Control Exposition and Convention, American Society for Quality Control, Cleveland Public Hall and Hotel Sheraton, Cleveland, Ohio.

May 25-28—Design Engineering Show and Conference, American Society of Mechanical Engineers, Convention Hall, Philadelphia, Pa.

May 26-28—Supersonic Transport Meeting, San Diego Section, Institute of the Aeronautical Sciences, San Diego, Calif.

June 1-3—National Symposium, Institute of Radio Engineers' Professional Group on Microwave Theory & Techniques, Harvard University, Cambridge, Mass.

June 4-5—Third National Conference, Institute of Radio Engineers' Professional Group on Production Techniques, Villa Hotel, San Mateo, Calif.

June 5-6—Annual Meeting of the Army Aviation Assn. of America, Shoreham Hotel, Washington, D. C.

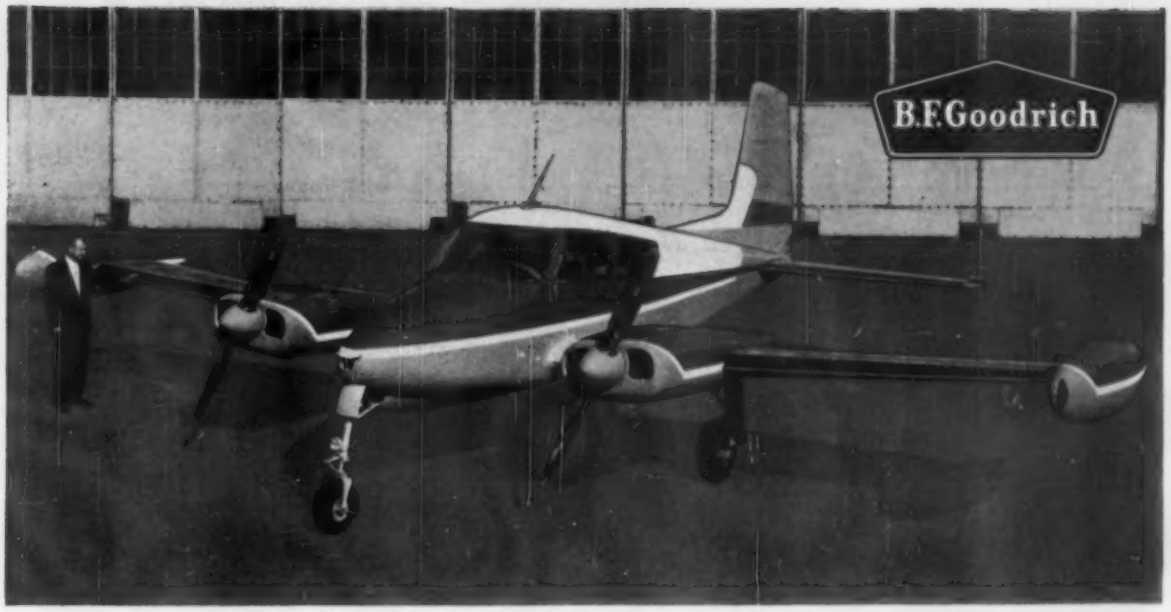
June 8-11—Semi-annual Meeting and Astronautical Exhibition, American Rocket Society, El Cortez Hotel, San Diego, Calif.

June 12-21—23rd French International Air Show, Le Bourget, Paris, France.

Aug. 31-Sept. 5—10th Annual Congress, International Astronautical Federation, Church House, Westminster, London.

Sept. 7-13—1959 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.

Oct. 12-16—15th General Convention of the International Air Transport Assn., Tokyo, Japan.



New B. F. Goodrich Lightweight De-Icers FAA-approved for Cessna 310

THE NEW Federal Aviation Agency has granted a Supplemental Type Certificate No. SA1-293 for the unique B. F. Goodrich Lightweight Pneumatic De-Icer system on all models of Cessna 310 aircraft.

Operating on a closed system of compressed air, this new Lightweight De-Icer is the first and only practical, low cost ice protection ever developed for light planes. There are no electrical connections, and weight, complete, is approximately 50 pounds.

Source of compressed air is a compact reinforced plastic accumulator that can be removed for extra load capacity during summer flying. The accumulator is guaranteed for 10,000 recharges at 3,000 psi. At this pressure the system provides enough energy for 6 to 7 hours of positive de-icing action when operated on a 3-minute cycle.

A complete kit is now available for all models of Cessna 310 aircraft—and kits for other light twin planes will be available soon. Completely FAA-approved, the system will perform satisfactorily between −65°F. and 200°F. Cycle and time life is the same as for B. F. Goodrich De-Icers used on the largest aircraft.

Contact your local B. F. Goodrich Aviation Products distributor and see how easily you can equip your own plane with this low cost ice protection. Or write *B. F. Goodrich Aviation Products, a division of The B. F. Goodrich Company, Dept. AW-49A, Akron, Ohio.*

B. F. Goodrich Aviation Products Distributors

AIRCRAFT PARTS CO.
Atlanta, Georgia

AIRWORK CORPORATION
Atlanta, Georgia
Cleveland, Ohio
Jamaica, L. I., New York
Miami, Florida
Newark, New Jersey
Washington, D. C.

BUTLER AVIATION
Chicago, Illinois
Milwaukee, Wisconsin
Rockford, Illinois

CENTRAL AERO SUP., INC.
Philadelphia, Pennsylvania

GENERAL AIRCRAFT SUPPLY CORPORATION
Detroit, Michigan

GENERAL AVIATION SUPPLY CO.
Houston, Texas
Oklahoma City, Oklahoma

DON HORN COMPANY
Memphis, Tennessee

LANG AIRCRAFT SUPPLIES
Omaha, Nebraska

LOUISVILLE FLYING SERVICE
Louisville, Kentucky

MIDWEST AIRWAYS, INC.
Milwaukee, Wisconsin

MINNESOTA AIRMOTIVE, INCORPORATED
Minneapolis, Minnesota

MUNCIE AVIATION CORPORATION
Muncie, Indiana

NAVCO, INC.
St. Louis, Missouri

PACIFIC AIRMOTIVE CORPORATION
Burbank, California
Denver, Colorado
Oakland, California
Seattle, Washington

PIEDMONT AVIATION, INCORPORATED
Winston-Salem, North Carolina

SKYMOTIVE, INC.
Chicago, Illinois

SKY STORE
Hawthorne, California

SOUTHWEST AIRMOTIVE COMPANY
Dallas, Texas
Denver, Colorado
Kansas City, Kansas

B.F.Goodrich ***aviation products***

XIX

This is the nineteenth of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.

Determining the Proper Depth of Case in Alloy Steels

In the previous article of this series we discussed the carburizing of alloy steels, pointing out that the purpose of carburizing is to provide a hard, abrasion-resistant outer shell or "case." Such a discussion naturally gives rise to the question, What factors influence the choice of case? Should it be shallow? Medium? Deep or extra-deep?

While it is not always wise to formulate hard-and-fast rules, the following may be used as a general yardstick:

Shallow cases (less than 0.02 in.). Suitable where wear-resistance alone is the chief requirement, and where good surface condition after heat-treating is advantageous. Not suitable if high stresses are apt to be encountered in service.

Medium cases (0.02 to 0.04 in.). For high wear-resistance. Will stand up under substantial service loads and stresses. The thickness is sufficient to permit certain finishing operations, such as light grinding.

Medium-to-deep cases (0.04 to 0.06 in.). For high wear-resistance. A case in this depth range is essential where continuing friction is involved, especially friction of an abrasive or semi-abrasive nature. It is also a good precautionary measure where application of the finished part may sometimes involve crushing action.

Extra-deep cases (more than 0.06 in.). Cases of this depth can be obtained by extending the furnace time in pack carburizing. Highly wear-resistant, they also withstand shock and impact. A large camshaft of an internal-combustion engine is a good example of a part requiring the extra-deep case. This is of course particularly true of the cam lobes themselves.

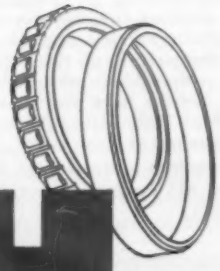
If you require specific advice concerning case-hardened parts, by all means communicate with our Metallurgical Division. Bethlehem technicians are always on call, and you can depend on their recommendations. And you can depend on Bethlehem, too, when seeking new supplies of alloy steels; for Bethlehem makes the full range of AISI standard grades, as well as special-analysis steels and all carbon grades.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

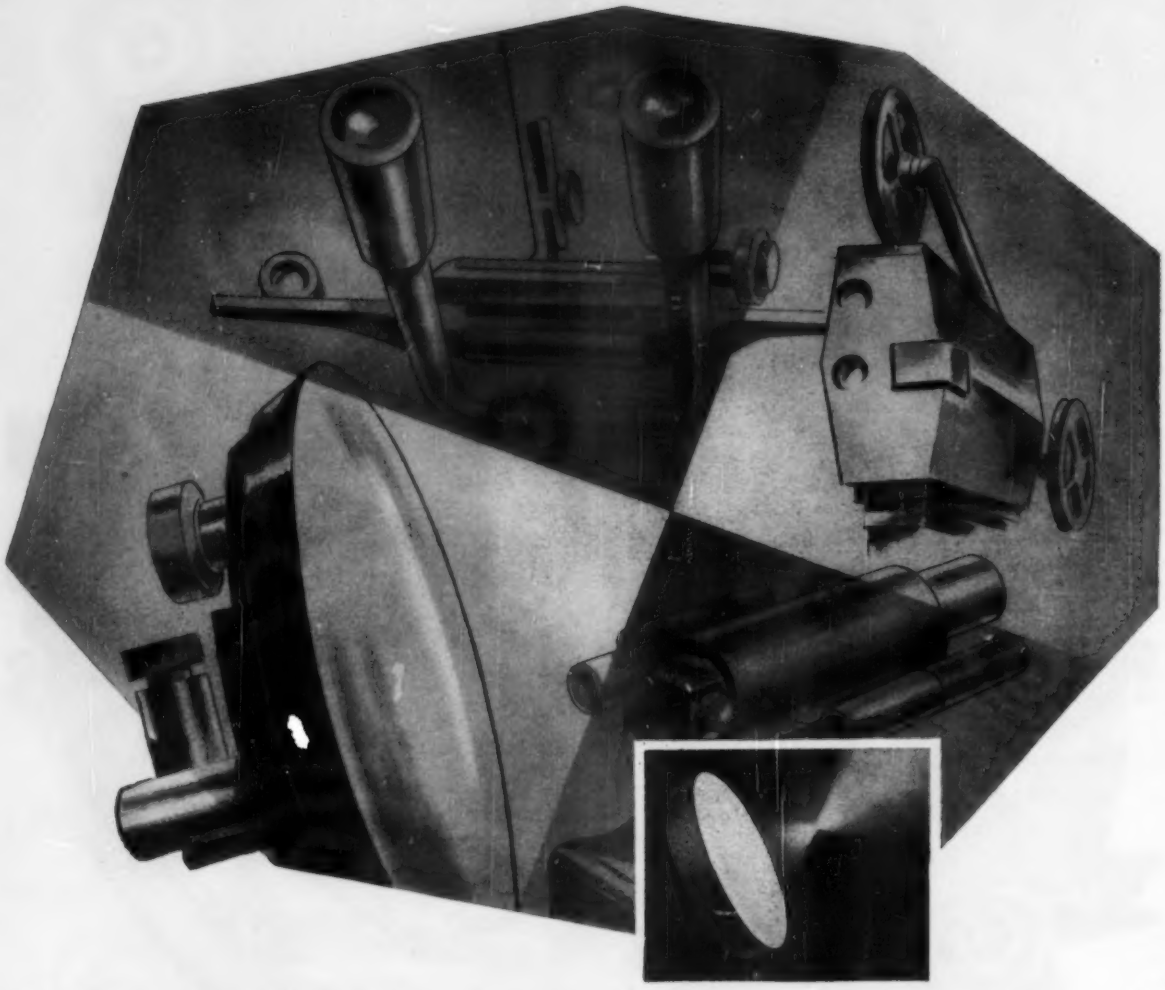
THE WORLD'S MOST MODERN AIRCRAFT ENGINES ARE FLYING HIGH WITH HYATT HY-ROLLS



HYATT HY-ROLL BEARINGS play an important part in the most critical applications of today's modern aircraft. Whether you manufacture jets or 'copters . . . turn to HYATT for assured bearing dependability. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

Another GM GENERAL MOTORS contribution to aviation progress

HYATT HY-ROLL BEARINGS FOR AIRCRAFT INDUSTRY



Unbreakable Repli-Kote Mirrors out-perform glass, slash costs

These new lightweight, low distortion Repli-Kote Mirrors of cast epoxy resin offer design engineers optical reflectors with a matchless combination of properties, impossible with glass. A single master mirror is all that's necessary for mass producing precision Repli-Kote Mirrors—at significant cost savings.

Optical Precision — 6″—5¼″ Focal Length Repli-Kote paraboloid mirrors have been produced in quantity with an accuracy permitting 90% of incident collimated light to be concentrated within a disc of 0.1 mm diameter. Higher rate of thermal diffusion through epoxy also lowers distortion caused by temperature transients.

Permanent Reflective Surface — High vacuum applied, silicon monoxide protected aluminum reflective surface is *permanently* bonded to epoxy backing, will resist flaking or peeling for extended periods.

High Mechanical and Thermal Shock Resistance — Repli-Kote Mirrors have withstood impacts *as severe as 22,000 g*, undergone rapid temperature cycling from −55°C to +125°C with no measurable physical change.

Light Weight—Repli-Kote Mirrors cast of epoxy are much lighter than glass. Suitable fillers can be added if desirable.

Any Shape—Paraboloids, hyperboloids, ellipsoids and more complex aspheric surfaces not previously reproducible in glass by mass production methods can now be quickly fabricated.

Ease of Mounting—Fixtures, threaded inserts, electrical components can be molded directly into the mirror backing, opening an almost limitless field of design possibilities. Repli-Kote Mirrors are also easily machined.

If you are working on tracking and guidance systems—or any system employing reflective optics—durable, lightweight, precision Repli-Kote Mirrors offer you greater design and production freedom. Let us help you make the most of Repli-Kote Mirrors in building a better product at lower cost.

Address Inquiries *to Repli-Kote, Singer-Bridgeport, 915 Pembroke Street, Bridgeport 8, Conn.*

SINGER

MILITARY PRODUCTS DIVISION

THE SINGER MANUFACTURING COMPANY

Military Products Division • 149 Broadway, New York 6, N. Y.

HRB • DIEHL • BRIDGEPORT

1385

One in a series of technical reports by Bower

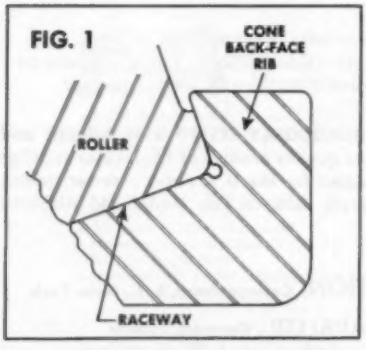
BEARING BRIEFINGS

BEARING GEOMETRY MAKES OR BREAKS BEARING PERFORMANCE

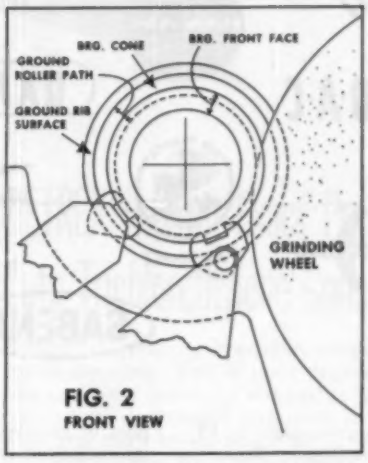
To develop high capacity and optimum performance in a tapered roller bearing, it is essential that roller alignment be accurate. Correct roller alignment, in turn, depends on a critical geometric relationship between the cone back-face rib, and the cone raceway.

Perfection in this geometric relationship compels the rollers to align themselves perfectly with respect to the bearing geometry, and each roller shares equally in the work that is imposed. Figure 1 diagrams the important elements involved.

When this rib-to-raceway relationship is incorrect (because of either faulty bearing design or manufacturing inaccuracies), rollers experience misalignment and begin to skid and skew under load. As engineers know, poor performance and premature bearing failure are inevitable under these conditions.

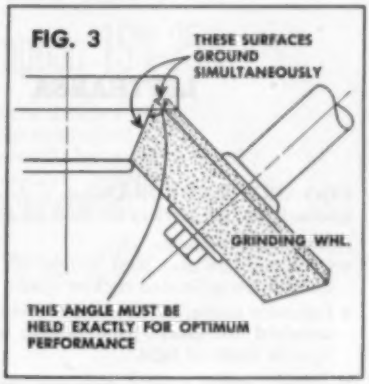


In the design and manufacture of Bower tapered roller bearings, Bower engineers take great care to generate and hold an exact face angle on the cone back-face rib. In practice, this means that Bower bearings are designed for maximum life and optimum performance under any operating conditions. It means that Bower bearings retain accurate roller alignment under all speeds and loads up to the maximum for which the bearing is rated.



It's one thing to develop proper bearing design on paper, but quite another to carry it out consistently in manufacture. To this end, Bower engineers were instrumental in the design and development of a unique centerless grinder on which Bower precision grinds each bearing's cone raceway and rib-face simultaneously. The results obtained from these machines invariably meet or surpass Bower's exacting requirements and assure perfect roller alignment.

Figures 2 and 3 are front and side views which illustrate Bower's technique of centerless grinding rib-faces and cone raceways together. As a result, every component in a Bower bearing is perfectly concentric about its rolling axis.



★ ★ ★ ★

When you require bearings, we suggest you consider the advantages of Bower bearings. Where product design calls for tapered or cylindrical roller bearings or journal roller assemblies, Bower can provide them in a full range of types and sizes. Bower engineers are always available, should you desire assistance or advice on bearing applications.

BOWER ROLLER BEARINGS

BOWER ROLLER BEARING DIVISION — FEDERAL-MOGUL-BOWER BEARINGS, INC., DETROIT 14, MICHIGAN

HERE'S WHY ~~12~~ 13 INTERNATIONAL CARRIERS SELECT

Edo LORAN

FOR JET-AGE LONG RANGE NAVIGATION

KLM ROYAL DUTCH AIRLINES · PAN AM · SAS · NORTHWEST AIRLINES · B·O·A·C · QANTAS · AIR FRANCE · VARIG · SWISSAIR · AA · CUBANA · LUFTHANSA · SABENA

EDO AIRBORNE LORAN has, to date, been specified by 13 international air carriers for their jet and turbo-prop fleets.

Here are a few reasons why:

- Compact size and total weight of 29 lbs., designed for installation in limited cockpit space.
- Indicator scope, on adjustable swivel base or mounted in standard instrument panel cutout, is easy to read in daylight or artificial light.
- Direct-reading control unit, measuring 5¾" x 4⅛", gives pilot or co-pilot instant line-of-position information—no interpolations or special training required.
- Pinpoint position fixes obtained in less than one minute.
- Complete dependability—all-new design featuring miniaturized circuits assures utmost reliability for aircraft operation.
- Fail-safe characteristic rules out possibility of error.
- All-channel availability—Edo Airborne Loran operates on all loran channels, assures world-wide loran coverage.

Complete Model 345 Loran. Receiver fits standard ¾ ATR rack

EDO LORAN HAS BEEN THOROUGHLY TESTED over Atlantic and Pacific air routes. It's another quality product of Edo, major supplier of advanced electronic systems for the U.S. Navy — sonar, radar, ASW equipment. For complete data on Edo Model 345 Airborne Loran address Dept. 4-C.

EDO CORPORATION, College Point, L. I., New York

EDO (CANADA) LTD., Cornwall, Ontario

Export Representative

AEROMARITIME, Inc., 1000 Vermont Ave., N.W., Washington, D. C.

Edo SINCE 1925

Manufacturers of a Trusted Line of Marine and Airborne Electronic Equipment

DETREX

Have You Had Your Degreasing Operation Checked Lately?

DETREX Has an Exact Procedure That Often Cuts Trichlorethylene Consumption 15%-25%

Solvent degreasing is a most economical method of metal cleaning. Yet, if your degreasing operation has not been carefully studied *very recently* by a competent degreasing engineer, it is entirely possible that you may be spending 25% more dollars for trichlorethylene than is necessary.

Most causes of excessive trichlorethylene consumption can be corrected quite promptly when the proper, exact procedure is followed:

1) Operational study by a qualified degreasing engineer.
2) Evaluation of his findings by a committee of chemists and engineers for determination of the necessary facts and recommendation of corrective measures.
3) Supervision of the corrections by the experienced engineer.

Our experienced degreasing engineers will be pleased to study your operation.

Depend on DETREX for Every Metal Cleaning and Processing Need

- PERM-A-CLOR NA (Trichlorethylene)
- Solvent Degreasers
- Ultrasonic Equipment
- Industrial Washers
- Phosphate Coating Compounds
- PAINTBOND Compounds
- Aluminum Treating Compounds
- Alkali and Emulsion Cleaners
- Rust Proofing Materials
- Extrusion and Drawing Compounds
- Spray Booth Compounds

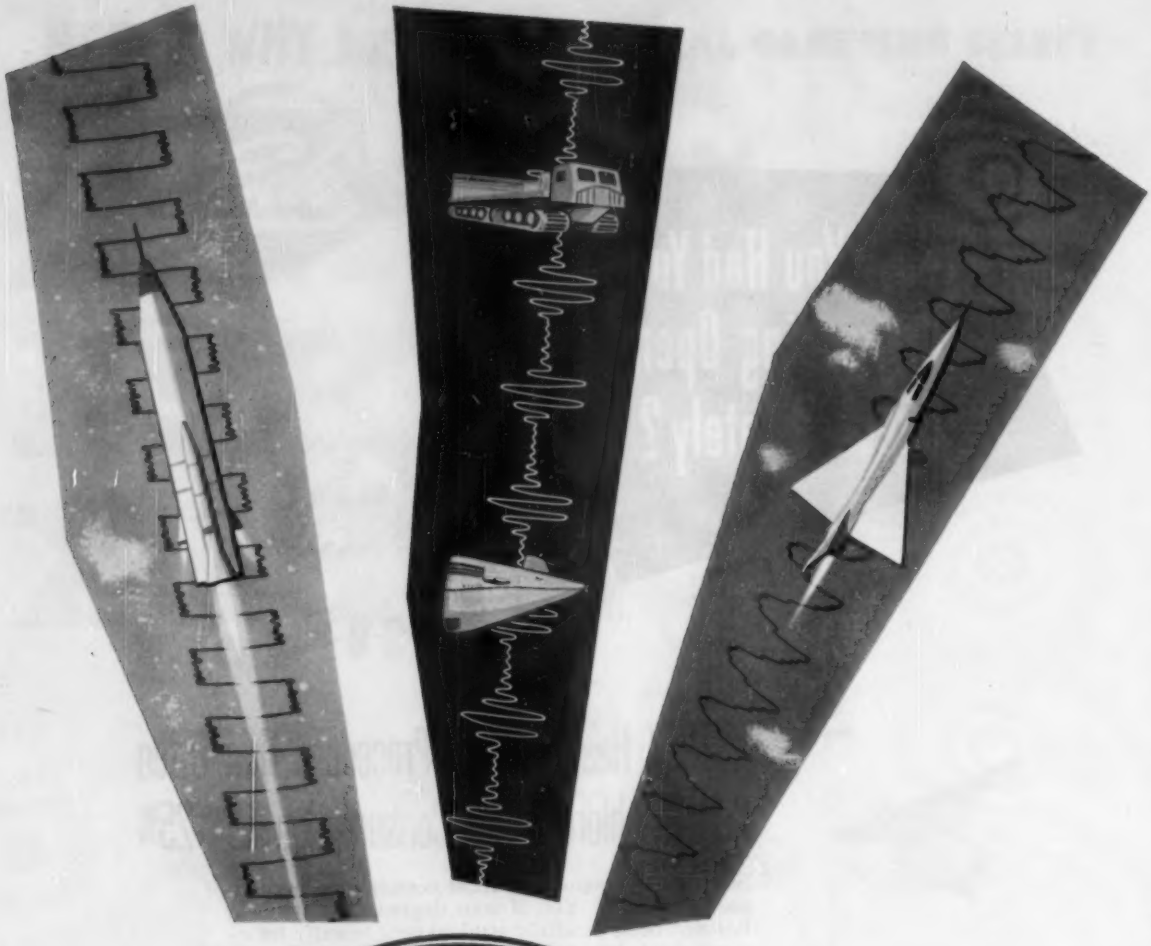
Send for Dr. W. L. McCracken's Informative Paper "Solvent Degreasing, a Valuable Industrial Process"

DETREX CHEMICAL INDUSTRIES, INC.

Box 501, Dept. AW-459, Detroit 32, Mich.

World's Largest Exclusive Producer of Cleaning Chemicals and Equipment

FOR OPTIMUM PROTECTION FROM VIBRATION/SHOCK/NOISE



utilize LORD capabilities

Greater reliability—*your* problem? LORD can help you do something about it. Protective mounting systems, designed, tested and produced at LORD, insure high reliability for sensitive equipment.

LORD is a diversified, capable technical organization, supported by modern facilities and prepared to complete challenging assignments in controlling vibration, shock and noise.

Your project can benefit from experience gained in working on Atlas, Talos, Jupiter, B-58, F-105, F11F, Convair 880, ground support, vehicular, shipboard, submarine and other advanced classified projects.

LORD is ready to work as an integral member of your team.

LORD MANUFACTURING COMPANY · ERIE, PA.

FIELD ENGINEERING OFFICES

ATLANTA, GEORGIA · CEdar 7-9247
BOSTON, MASS. · HAncock 6-9135
CHICAGO, ILL. · Michigan 2-6010
DALLAS, TEXAS · Riverside 1-3392
DAYTON, OHIO · BAldwin 4-0351
DETROIT, MICH. · Diamond 1-4340
KANSAS CITY, MO. · WEstport 1-0138
LOS ANGELES, CAL. · HOllywood 4-7593
NEW YORK, N. Y. · Circle 7-3326
PHILADELPHIA, PA. · PEnnypacker 5-3559
SAN FRANCISCO, CAL. · EXbrook 7-6280

"In Canada—Railway & Power Engineering Corporation Limited"

THE ALUMINA CARPET: SPRINGBOARD TO THE STARS...

THIS IS one of our main missile launching pads. Someday, when we have not only orbited the moon, but have sent our gleaming vessels to Mars and Venus and beyond, it may become a national shrine. With a plaque that says, in effect, "*Here it all began . . .*"

RIGHT NOW, it's not especially exciting compared to the exciting things that have happened above it —*unless* you're interested in modern industrial refractories. Then you'll notice that this pad, like other major missile-launching sites in the United States, is paved with materials containing aluminas.

WHY ALUMINAS? Because the holocaust of heat from a missile's takeoff makes the interior of a blast furnace seem cool by comparison. Because only modern ceramic technology, working with today's advanced aluminas, can produce an ideal pad that takes such a blast in its stride . . . and then stands ready, willing and eager for the *next* shoot.

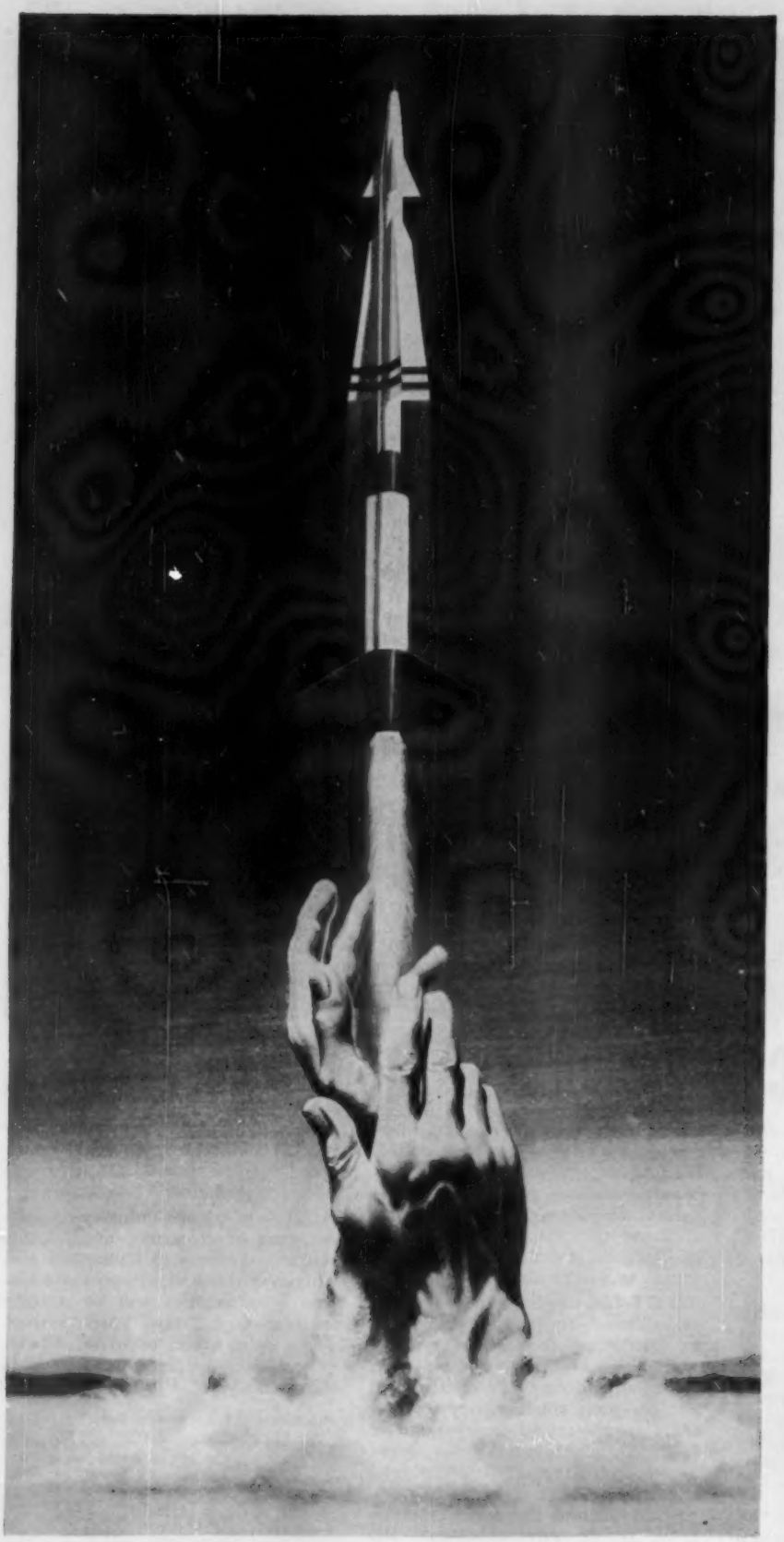
NO OTHER material—in rockets or *under* them—combines such desirable attributes of high mechanical strength at high temperatures . . . outstanding dielectric properties . . . and complete transparency to electrical, magnetic and electromagnetic fields. Alcoa® Aluminas today, in radomes, insulators and flame-sprayed aluminum oxides, impart electrical, mechanical and thermal properties never before obtainable. And the strong, lightweight Alcoa Aluminum alloys themselves, of course, are more essential than ever in advanced airframe and missile production.

ALCOA offers the industry's greatest fund of experience in *all* forms and applications of aluminum and aluminas. If this experience can assist you, your inquiry will be warmly welcomed. Contact your nearest Alcoa sales office, or write: Aluminum Company of America, 2026-D Alcoa Building, Pittsburgh 19, Pa.

Your Guide to the Best in Aluminum Value

ALCOA ALUMINUM

For Exciting Drama Watch "Alcoa Theatre," Alternate Mondays, NBC-TV, and "Alcoa Presents," every Tuesday, ABC-TV



rockets and missiles

Componentry capabilities of the Kelsey-Hayes Company as a supplier of precision propulsion assemblies, structural parts and exotic high temperature materials for first and second generation rockets and missiles include—
Swivel nozzles, hydraulic control systems and auxiliary power supply systems for thrust vector control; weldments, rocket and combustion chambers for liquid and solid propellant propulsion systems; inner cones, exhaust cones, rotating wheel assemblies; vacuum induction melted alloys to withstand corrosive and extremely high temperature atmospheres; advanced design, research and development in gas dynamics, internal ballistics, transient heat and thermal stress analysis.
Kelsey-Hayes Company,
General Offices: Detroit 32, Michigan

KELSEY-HAYES COMPANY

Automotive, Aviation and Agricultural Parts
Hand Tools for Industry and Home

18 PLANTS: Detroit and Jackson, Michigan; Los Angeles; Philadelphia and McKeesport, Pennsylvania; Springfield, Ohio; New Hartford and Utica, New York; Davenport, Iowa; Windsor, Ontario, Canada.

K H

AEROJET

for gunfire control

INFRARED FOR THE F-104

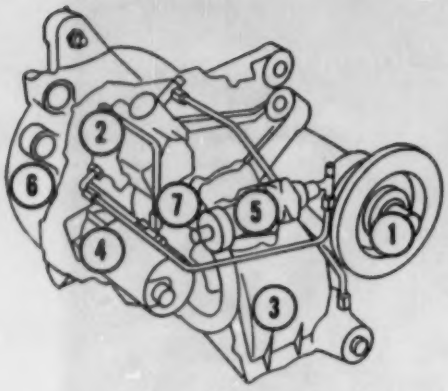
Nighttime capability for the Lockheed F-104 Starfighter is achieved with an Aerojet IR fire control system. A product of our Avionics Division at Azusa, California, it is the only equipment of this type in operation today. Aerojet's Avionics Division constitutes the nation's largest engineering group devoted to research, development, and manufacture of infrared systems.

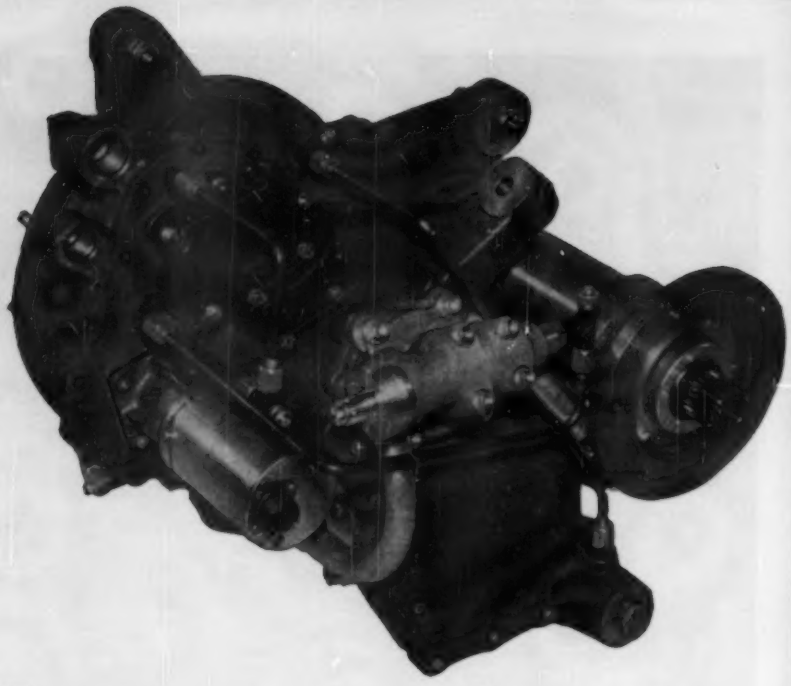
AEROJET-GENERAL CORP.

THE GENERAL TIRE

A SUBSIDIARY OF THE GENERAL TIRE AND RUBBER COMPANY

Engineers, scientists—*investigate outstanding opportunities at Aerojet. (Plants at Azusa and near Sacramento, Calif.)*





1 —INPUT SHAFT
Accepts varying input speeds from 3800-7000 RPM.

2 —GOVERNOR
Maintains ±0.25% steady state speed over 200° F temp. range, ±0.5% for 400° F temp. range and 0.5 second maximum full load transient recovery time.

3 —VARIABLE DISPLACEMENT PUMP/MOTOR
Either pump or motor, depending on whether it is adding to or subtracting from drive speed.

4 —OVERSPEED GOVERNOR
Senses a predetermined excessive speed to prevent drive overspeeding.

5 —MAIN SYSTEM RELIEF VALVE
Overload protection for hydraulic system.

6 —DIFFERENTIAL GEAR SECTION
Ring, sun and planet gears. Also includes take-off gears for governors, scavenge and make-up pumps.

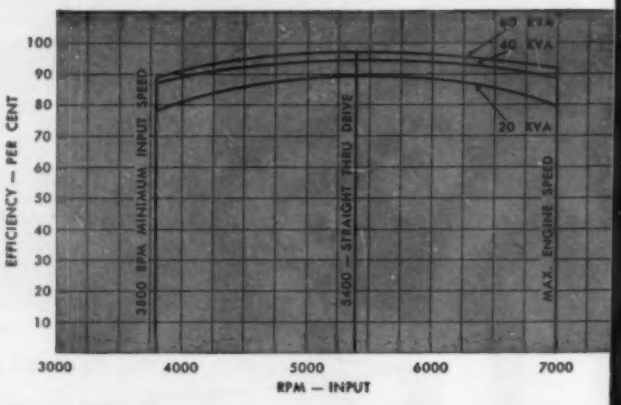
7 —FIXED DISPLACEMENT MOTOR/PUMP
Drives, or is driven by, sun gear to control output speed at 6000 rpm in response to fluid flow exchange with variable delivery unit.

A SIGNIFICANT ADVANCEMENT—

Differential Type Constant Speed Drive For Aircraft Alternators

Tests now in progress on this 60 kva Vickers Differential Type Constant Speed Drive are proving its outstanding performance. (See curves) It combines Vickers dependable hydraulic pumps and motors with planetary gearing to provide a more efficient and lighter "package" than drives now available.

The differential type constant speed drive is a direct engine-driven transmission that can be either engine pad mounted or universal shaft driven. It employs the "differential drive" principle wherein the planetary gear train is the principal power vehicle and the hydraulic components differentially add or subtract speed and power to maintain constant output speed. For further information, write for Bulletin A-5221.



Performance of Vickers 60 kva Differential Type Constant Speed Drive at three different loads. The high efficiency requires minimum support equipment for cooling with minimum penalty for high temperature operation (400°F oil temp.)

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Aero Hydraulics Division
Engineering, Sales and Service Offices:
ADMINISTRATIVE and ENGINEERING CENTER
Department 1462 • Detroit 32, Michigan
TORRANCE, CALIFORNIA • 3201 Lomita Boulevard
P.O. Box 2003 • Torrance, California

April 20, 1959

Aviation Week

Including Space Technology

Vol. 70, No. 16
Member ABP and ABC

EDITORIAL OFFICES: New York 36—330 W. 42nd St., Phone: LOngacre 4-3000 (Nights LO 4-3035) Washington 4, D. C.—National Press Bldg., Phones: NAtional 8-3414, REpublic 7-6630 Los Angeles 17—1125 West Sixth St., Phone: HUntley 2-5450 Dallas 1—1712 Commerce St. Phone: Riverside 7-5117 European Office—1 rue du Temple, Geneva, Switzerland, Phone: 32-35-63

PUBLISHER .....Robert W. Martin, Jr.
EDITOR.....Robert B. Hotz

MANAGING EDITOR.....William Gregory
EUROPEAN EDITOR.....David A. Anderton
WASHINGTON.....Cecil Brownlow
NEW YORK..Robert I. Stanfield, Harry Raven, Herbert J. Coleman
LOS ANGELES..Irving Stone, Richard Sweeney, Russell Hawkes, William S. Reed
DALLAS.....Craig Lewis
ENGINEERING..J. S. Butz, Jr., Michael Yaffee
AVIONICS...Philip J. Klass, James A. Fusca
CONGRESS..Katherine Johnsen, Ford Eastman
SPACE TECHNOLOGY.....Evart Clark
TRANSPORT.....Glenn Garrison, L. L. Doty, Robert H. Cook
EQUIPMENT.....Barry Tully
BUSINESS FLYING.....Erwin J. Bulban
ART EDITOR.....Lawrence J. Herb
SPECIAL PROJECTS .....John A. Nammack
EDITORIAL PRODUCTION....Arnold Sherman
ASSISTANT EDITORS....Elizabeth M. Hein, Edith Walford
EDITORIAL ASSISTANTS.....Marjorie Nail, Jerome Bailey, Marjorie Todd
LIBRARIAN .....Eleanor Milano

FOREIGN NEWS SERVICE

EDITOR.....John Wilhelm
LONDON.....John Tunstall
PARIS.....Robert E. Farrell
BONN.....Morrie Helitzer
MEXICO CITY.....Peter Weaver
TOKYO.....Sol Sanders

DOMESTIC NEWS BUREAUS

ATLANTA 3.....1301 Rhodes-Haverty Bldg.
CHICAGO 11.....520 No. Michigan Ave.
CLEVELAND 15.....1510 Hanna Bldg.
DETROIT 26.....856 Penobscot Bldg.
HOUSTON 25.....1303 Prudential Bldg.
SAN FRANCISCO 4.....68 Post St.

SALES

ADVERTISING SALES MANAGER E. P. Blanchard, Jr.
ATLANTA.....R. H. Powell
BOSTON.....A. C. Boughton
CHICAGO and ST. LOUIS.....J. S. Costello, D. C. Jackman
CLEVELAND.....H. P. Johnson
DALLAS.....R. T. Wood
DENVER.....John G. Patten
DETROIT.....R. R. Butera
LOS ANGELES.....C. F. McReynolds, D. T. Brennan, C. A. Ransdell
NEW YORK.....M. J. Storz, J. M. Grinton, J. D. Warth
PHILADELPHIA..J. D. Willis, W. L. Blanchard
SAN FRANCISCO.....William Woolston
PROMOTION & RESEARCH MGR..C. C. Gersna
RESEARCH AND MARKETING Mary Whitney Fenton, Jacqueline Gonnet

BUSINESS

BUSINESS MANAGER.....J. G. Johnson
CIRCULATION MANAGER.....T. J. Lucey
ASST. BUSINESS MANAGER ..W. V. Cockren
PRODUCTION MANAGER.....F. A. Dube

Discoverer II Orbital Attitude Controlled..... 26
► Satellite maintained constant orientation in regard to earth until re-entry unit's ejection shifted mass.

Domestic Traffic May Hit Record Year..... 39
► Best first quarter volume in history strengthens confidence in $3 billion re-equipment program.

Space Trainer Simulates Hypersonic Orbit..... 56
► Chance Vought orbital navigation simulator is designed to explore unknown factors in hypersonic glider operations.

SPACE TECHNOLOGY

Discoverer II Orbital Attitude..... 26
Centaur Engine Firing..... 26
Mercury Pre-Orbit Plans..... 28
Satellite Injection Angle..... 33
Million lb.-Thrust Engine..... 34
Hypersonic Orbit Simulated..... 56
Soviet Meteorological Rocket..... 57
Republic Unmanned Space Vehicle... 59
Project Mercury Candidates..... 64

AERONAUTICAL ENGINEERING

Convair 540 Capabilities Boosted... 103
T-38 Talon First Flight..... 27
Sikorsky Rolls Out S-60..... 29
Grumman Mohawk First Flight..... 30
Vertol YHC-1 Configuration..... 31
Mirage 4 Details..... 33
External Burning Efficiency Studied.. 94
Production Briefing..... 98

BUSINESS FLYING

Executive Commuter Service..... 113
U. S. Business Aircraft Shipments... 113
Private Lines..... 114
Spin Causes Beech Crash..... 116

AIR TRANSPORT

Domestic Traffic May Hit Record.... 39
Douglas Reports Losses..... 34
Airline Fare Cuts Foreseen..... 40
Eastern's Cockpit Authority..... 41
Northwest Files to Block BOAC..... 42
British Supersonic Airliners..... 43
National's Low Fare Proposal..... 43
Airline Income & Expenses—1958... 44
Airlines Report Salaries, Bonuses.... 45
Western Regional Concept..... 49
Shortlines..... 54
Airline Observer..... 54

MANAGEMENT

Weapon System Concept Defended.. 31
Defense Electronic Survey..... 32
SAC Deterrent Capability..... 66
Who's Where..... 23
Industry Observer..... 23
Washington Roundup..... 25
News Digest..... 34

Calendar..... 5
Letters..... 134

EDITORIAL

Lessons of History..... 21

COVER: Sikorsky's S-60 flying crane last week demonstrated its load carrying capabilities, including a 1,200 lb. mockup of the Army's Honest John missile. The crane also lifted a 4,500 lb. Army bridge section and placed it on two dummy fixtures. The crane, powered by two Pratt & Whitney R2800 piston engines, has a payload capacity up to six tons, depending on range (see p. 29).

PICTURE CREDITS

Cover—Sikorsky; 27—Noreir; 30—Grumman; 31—Vertol Aircraft Corp.; 41—Lockheed; 42—de Havilland; 47—Eastern Air Lines; 49—Fairchild; 53—National Airlines; 56—Chance Vought; 59—Republic Aviation Corp.; 61—Garrett Corp.; 64, 65, 94, 95—NASA; 66—USAF; 94 (top)—Aviation Week; 103, 104—Canadair Ltd.; 114—Doman Helicopters, National Aeronautical Corp.; 116—North American Aviation.

76,383 copies of this issue printed

. . and there are hundreds in an air-launched missile

Send for free illustrated brochure

. . . But the final and most crucial moments occur in the quiet loneliness of "out there" when the missile locates, tracks and detonates. These final moments don't depend upon reliability . . . they *are* RELIABILITY.

The Light Military Electronics Department of General Electric has supplied, and is now supplying, weapon system contractors with electronic subsystems and equipments with top-level reliability.

Product Design and Production of Missile Guidance Digital Computers and portions of Submarine Fire Control Computers for Polaris . . . Design and Production of Radio Guidance for ATLAS . . . Quantity Production of Infrared Guidance and Control units for SIDEWINDER . . . such capabilities are available to you in any or all of these areas:

AIRBORNE COMPUTERS: Analog and Digital (Including Variable Increment Techniques • Fire Control • Guidance and Control • **FLIGHT CONTROL** • Aerodynamic • Reaction • **GUIDANCE AND HOMING** • Inertial • Infrared • Radar • Digital Command • **RE-ENTRY ELECTRONICS** • High Temperature Amplifiers and Circuits • High Temperature Fluid Systems • Liquid Metal Hydraulics • **COUNTERMEASURES AND ANTI-JAMMING TECHNIQUES** • **TELEMETERING** • **RADIATION FUZING (all types)**

For brochure "MOMENTS OF PROOF . . . From Design to Detonation," contact Manager — Missile Sales, Light Military Electronics Department, French Road, Utica, New York, Dept. 10F.

LMED

GENERAL ELECTRIC

LIGHT MILITARY ELECTRONICS DEPARTMENT
FRENCH ROAD, UTICA, NEW YORK

A DEPARTMENT IN THE DEFENSE ELECTRONICS DIVISION

EDITORIAL

Lessons of History

Recently we journeyed northward through the rain, sleet and fog of a reluctantly departing winter to the campus of the Massachusetts Institute of Technology for the inauguration of the Lester Durand Gardner memorial lecture series. Maj. Gardner, among the other considerable achievements during his lifetime, founded Aviation magazine in 1916 as the first aeronautical publication in this country. Purchased in 1928 by the McGraw-Hill Publishing Co., this magazine has come down in a direct, continuous line to the present format of AVIATION WEEK which is still flying the same editorial policy flag nailed to the masthead by Maj. Gardner 43 years ago:

"The future of the aeroplane will depend largely on the use that is made of the technical information that is being gathered in all parts of the world. . . . Aviation magazine intends to assemble this vast amount of material and make it useful to the constructor, the engine maker, the aviator and the sportsman in accurate, scientific and unbiased form."

This is an editorial policy that has weathered the acid test of time and remains unchanged in an industry that has galloped through the most revolutionary technical developments in the history of man, from the sands of Kitty Hawk to the infinity of outer space.

Delivering the first Lester Gardner lectures was Grover Loening, a living link with the Wright brothers for whom he worked as manager of their Dayton factory in 1913–14, the designer of Loening amphibian and a creator of aeronautical history in the three decades since he learned to fly in 1911. With the perspective of his long view of aviation from its very beginnings to its first bursts into outer space, spiced by the specific anecdotes of personal experience with the governmental bureaucracy that still appears to be the fastest growing element of aviation, Mr. Loening provided the M.I.T. students and distinguished guests who filled the Kresge theater with a rare analyses of the lessons that can be distilled from this span of aviation history.

Legendary Figures

It is a lecture that should be widely repeated among the younger groups of engineering students, military officers and others in the field to whom the Wright brothers, Glenn Curtiss, Tony Fokker, Charles Lawrence, Sylvanus Reed and other technical pioneers who were Grover Loening's contemporaries, are just legendary figures from the pages of books or inscriptions on memories and record placques.

In this brief space we cannot hope to record the full flavor of Mr. Loening's incisive sweep through the aeronautical past so splendidly documented from personal experience. But there are some points he made that have special significance to the new generations of technicians toiling in the field. For example, he provided a realistic roster of all the major technical developments which came to this country from abroad such as the tractor-type monoplane from France; the cantilever, stressed skin all-metal monoplane from Germany as early as 1920; high lift devices from Handley-Page and Lachmann, and down to the rear fuselage location of jet engines from the French Caravelle in modern times.

This is a sobering thought worth remembering in the fierce technical competition with the Soviet Union which engages us today.

And who remembers today that Glenn Curtiss successfully used the tricycle landing gear on his early aircraft some 35 years before this logical development began to be generally accepted?

"One of the outstanding lessons that we see clearly in such a review," Mr. Loening told his audience, "is how often designers and constructors have failed to finish up what was started. Due too often to discouraging initial troubles and 'bugs'—often added to by lack of foresight and interest on the part of aircraft customers, military, industrial and civilian—the continuity of effort for success frequently has died on the vine, with the result that badly needed and highly desirable developments that had been started were abandoned and laid dormant only to be revived years later."

Mr. Loening also had some sharp things to say about how the bureaucratic drag—both civil and military—of government agencies has artificially slowed the pace of our technical development.

"Russia seems to move quicker in reaching the hardware in-use stage after early inception," said Mr. Loening. "As nearly as we can ascertain they do not use our system. This we had better study. Instead of a 'requirements division,' we had better perhaps have a 'stimulation division'. . . . We are at a disadvantage, however, in operating in our private enterprise system because the expenditures of government have to be substantiated, audited, interminably reviewed, even to this day's unwarrantedly punitive renegotiation nonsense.

"An autocracy could go to its expert designers and say 'Here is your order for your next great design. Don't come near our bureaucracy until it is finished excepting to send us the bills which we will pay because your record gives us confidence.' This may be Russia's great secret—at any rate a review of our history indicates that our government processes and even our civil aviation processes should approach this as near as they can in order to shorten lead time, reduce the number of cooks putting their fingers into technical broth and letting the expert designer do what he wants including changing his mind.

"If he is successful the nation wins. If he is unsuccessful this cheaper method of development would save the government a larger loss."

One final thought from Mr. Loening:

"World history seems to show that anything man can clearly imagine eventually materializes into reality. Our air age has only just started, for in our travels and our movements of ourselves and our goods we are about to obsolete the wheel just as the wheel obsoleted the skid some 10,000 years ago."

Occasionally, it is necessary to look up from the drawing board, peer out of the cockpit or emerge from darkest Pentagonia to catch a look at the fresh shining vision of the future that Mr. Loening has painted from the experience of the past.

—Robert Hotz

Hard to see, harder to hit, the Rheem AN/USD-2 surveillance drone slips over hostile positions to show a closeup of enemy activities to battlefield commanders. In this high performance drone, the most advanced components are compressed into the smallest, most economical vehicle. Outstandingly successful in recent Signal Corps tests, the AN/USD-2 has already demonstrated range, utility, versatility remarkable in a vehicle of its size.

Miniaturization and component reliability is exemplified by the AN/USD-2's piston engine's fuel pump. Designed and built by Eastern Industries, this precision instrument is capable of delivering 0.4 gpm at 5.0 psi — yet takes up less space than a two-cell flashlight, weighs less than a pound without motor. Utterly reliable, it pumps a precisely calibrated flow of fuel to the powerplant—keeps the drone in the sky and on the lookout.

Eastern high speed gear pumps are small, light in weight — offer the widest performance range: speeds to 24,000 RPM, flow from .025 gpm to 2.0 gpm, pressures from 0 to 2000 psig. Weights with motor range from 1.5 to 8.5 lbs.

On your next pump problem, call in Eastern — and write for Bulletin 360, your complete guide to all Eastern aviation products.

AVIATION PRODUCTS

EASTERN INDUSTRIES, INC.

100 SKIFF STREET, HAMDEN, CONNECTICUT

West Coast Branch Office: 1608 Centinela Ave., Inglewood 3, Calif.

HYDRAULIC POWER • ELECTRONIC COOLING • REFRIGERATION-TYPE COOLING • PRESSURIZATION-DEHYDRATION • SERVO-VALVE HYDRAULIC SYSTEMS

WHO'S WHERE

In the Front Office

H. Rowan Gaither, Jr., and **Dr. Luis W. Alvarez,** directors, United Electrodynamics, Pasadena, Calif. Mr. Gaither, chairman of the Gaither Committee, is a member of the Ford Foundation; Dr. Alvarez is associate director and professor of physics, University of California, Lawrence Radiation Laboratory.

Dan A. Kimball, president of Aerojet-General Corp., a director, Technical Research Group, Inc., New York, N. Y.

C. H. Chichester Smith, board chairman, Fairey Aviation Ltd. and Fairey Engineering Ltd., subsidiaries of The Fairey Company Ltd., London, England. Also: **R. L. Lickley,** managing director of Fairey Aviation Ltd.; **H. G. Gregory,** general manager of Fairey Engineering Ltd.

Dr. Albert G. Hill, of Massachusetts Institute of Technology, a director and consultant to General Atronics Corp. and Atomic Products, Inc., Bala-Cynwyd, Pa.

Max W. Burrell, president, and **John D. Nyquist,** vice president and general manager, Alpha Corp., Dallas, Tex., new subsidiary of Collins Radio Co. Also named vice presidents: **D. C. Arnold,** for marketing; **Richard J. Flynn,** for finance; **Richard M. Ringoen,** for engineering.

J. Kenneth Hull, president, Lockheed Aircraft International, newly formed subsidiary of Lockheed Aircraft Corp., Burbank, Calif. Vice presidents are: **J. W. Clutter; W. D. Hammond; P. M. Willcox; W. Scott McGilvray. Ralph J. Osborn** succeeds Mr. Hull as president of Lockheed Aircraft Service.

E. Finley Carter, president, and **Weldon B. Gibson,** vice president, Stanford Research Institute, Menlo Park, Calif.

Allen F. Donovan, a vice president, named director of the newly established Advanced Systems Planning staff for advanced ballistic missiles and space systems, Space Technology Laboratories, Inc., Los Angeles, Calif.

Roy R. Brewton, vice president and controller, Convair Division of General Dynamics Corp., San Diego, Calif.

Arnold V. Pilling, vice president-engineering and planning, Aircraft Division of Ledkote Products Co., Long Island City.

Joseph A. Uhl, vice president and special assistant to the president, Continental Air Lines, Inc. **Alexander Damm** succeeds Mr. Uhl as vice president-finance.

Honors and Elections

Dr. John Hagen, director of the Vanguard project, has received the Navy's Distinguished Civilian Service Award "for exceptionally outstanding service . . . which resulted in the successful launchings of the earth satellites Vanguard I and Vanguard II. . . ."

Perry W. Pratt, vice president and chief scientist of United Aircraft Corp., has been appointed a member of the Scientific Advisory Board of the United States Air Force. Mr. Pratt will serve on the Propulsion Panel.

(*Continued on p. 123*)

INDUSTRY OBSERVER

► Hughes Aircraft Co. is a bidder in the competition for WS-138A, USAF's air launched ballistic missile. This brings the total to at least 14 companies (AW Mar. 30, p. 23 and April 6, p. 23). Missile will arm the Convair B-58 and North American B-70, and possibly the Boeing B-52. Decision on the weapon system contractor for the WS-138A is now expected between May 1 and May 15.

► **Inspection review team will see Boeing Airplane Co. team's Dyna-Soar I mockup at Seattle this week and the Martin Co. team's mockup next week. Decision on the Phase I competition must be made before July 1, could come as early as the last two weeks in May.**

► First operational Air Force-Convair intercontinental ballistic missile may be launched by an operational crew from Vandenberg AFB, Calif., as early as May 15.

► **Two of the four Atlas pads at Cape Canaveral, Fla., have been modified to accommodate space and satellite vehicles, including programed WS-117L shots, Atlas-Mercury capsule shots and the Vega and Centaur space vehicles.**

► Technical direction of the National Aeronautics and Space Administration's Vega vehicle program will be handled by NASA's Jet Propulsion Laboratory of the University of California. Vega uses an Atlas first stage and General Electric second stage. Later version will use a storable stage being developed by JPL.

► **Thiokol Chemical Corp. and Marquardt Aircraft Co. are discussing a possible merger, with a one-for-one stock exchange as a basis. This would be tantamount to acquisition of Marquardt by Thiokol, particularly in view of Marquardt's request for stockholders at their May 5 meeting to authorize two-for-one stock split to be made in the form of a 100% stock dividend. Thiokol also is discussing merger with other companies, including two in the nuclear field and one in the chemical field.**

► Solar panels for Advanced Research Projects Agency's WS-117L Sentry advanced reconnaissance system have been supplied by Hoffman Laboratories Division to Lockheed's Missile and Space Division. Panels probably will not be used or evaluated in any of the early Discoverer polar satellite firings, a phase that has been broken out of the over-all WS-117L program.

► **USAF-Douglas Thor IRBM priority rating may be down-graded except for units which would be funneled into the Discoverer north-south polar orbit firings scheduled from Vandenberg AFB.**

► Air Force's Ballistic Missiles Division is conducting an analysis of the amount of acceleration feasible for the Minuteman solid-propellant, multi-purpose ballistic missile program. Problem of logistics is the major item under consideration in the acceleration study.

► **Allison T63 250 shp. engine designed for helicopter and light aircraft installations (AW April 6, p. 73), was run on test stand for first time April 1. Initial run was for checkout purposes, lasted some 10 min. Army-sponsored free-turbine powerplant is currently six months ahead of schedule, according to sources close to the project.**

► Beech Aircraft won the competition for the alert pod for the North American B-70 Mach 3 bomber. Lycoming T53 turbine engine will be the power source (AW Nov. 3, p. 23). Others in the competition were Temco and Bendix Products Division. Contract will amount to $8 million.

► **Special site at Wendover AFB, Mass., is planned for testing of large explosive charges in connection with forthcoming Air Force evaluation programs. Wendover also may become a proving area for testing the solid propellant development of contracts associated with the Air Force missile program and located near Wendover.**

TRIPLE-THREAT RADAR

Tactical bombers of the future will have a triple capability for low-level operations because of Stavid's contributions to a new bomb-directing system. With this equipment, bombers will be able to ferret out the enemy by day or night . . . anywhere, regardless of terrain.

The radar system, incorporating search, bombing, and terrain-avoidance modes, is now being developed in Stavid's laboratories and represents the latest state-of-the-art in transistorized airborne electronics. Through modular techniques and systems integration, the radar equipment is designed to meet all tactical situations involving modern attack aircraft.

Other airborne electronics projects include:

- Radar-Infrared Fire Control System MK22 MOD O
- Radar-Infrared Search-Track Set AN/ASQ-13
- High Resolution Experimental Bombing System AN/APQ-49

Radar Systems Engineer, F. N. Bellew, now assigned to an advanced search and bombing radar system, has 15 years' experience in airborne electronics, including microwave systems, video amplifiers and cathode ray tube displays.

STAVID Engineering, Inc. Plainfield, New Jersey

Imaginative Electronics . . .

Outstanding engineers and scientists are invited to inquire into opportunities on Stavid's advanced systems engineering teams.

Washington Roundup

Nuclear Plane Push?

Rep. James Van Zandt (Pa.), ranking Republican House member of the Joint Congressional Committee on Atomic Energy, predicted last week that the Administration will propose an acceleration of the aircraft nuclear propulsion program following an all-day briefing session of key Administration and congressional officials at the Evendale plant of General Electric Co. (AW April 13, p. 25).

Van Zandt said the conflict between present Administration plans and the proposed accelerated program outlined by General Electric officials is "slight": "We would buy six to nine months of time, and pull down a couple of years on getting a plane into the air." The Administration plan is for a level program of $150 million a year. The expedited plan would involve a total additional of $250 to $280 million and set a target of mid-1962 for flight of the aircraft.

The big increase would be $100 million additional in Fiscal 1960.

"It is going to be worked out," Van Zandt said. He added that Deputy Secretary of Defense Donald Quarles expressed "only one" reservation at the sessions to the augmented program: "He pointed out that the ANP project would have to take its position in competition with other things for funds."

Rep. Melvin Price (D.-Ill.), chairman of the Joint Atomic Energy Subcommittee on Research and Development, said that the briefings by the technical personnel at the GE plant, under the direction of Roy Shoults, plant manager, "was the best technical presentation that has ever been made to the people who have the power of decision. It is now only a question of timing and money." Price said that a public hearing on the ANP program would be held "as soon as possible."

A Primate Facie Case

Space monkeys and secrecy have become the center of a bitter, free-swinging public controversy between Defense Department Counsel Robert Dechert and the House Government Information Subcommittee headed by Rep. John E. Moss (D.-Calif.).

Dechert last week accused the subcommittee of discourtesy, encouraging disrespect for the security system and aiding "the Communist propagandists who want to stir up trouble between us and other nations."

Moss in turn accused Dechert of "an unprovoked and unjustified attack" and said Dechert "should do a little more homework and jump to fewer conclusions."

Last Mar. 30, the subcommittee asked Defense Secretary Neil McElroy for an explanation of "apparent off-again-on-again secrecy" applied to monkeys used in research and cited a Defense memorandum on the subject classified "confidential" and signed by Assistant Secretary for Public Affairs Murray Snyder.

Dechert replied for McElroy, making the accusations and asking the subcommittee for the name of whatever Defense employe had apparently given it "information concerning classified matters," the date of the disclosure, the person to whom it was disclosed, whether it was oral or written "and other relevant facts."

Dechert said the memo is not now classified but attached correspondence, classified by the originating agency, must remain classified.

Moss then replied—to McElroy rather than Dechert—that he was happy to provide Defense with all facts concerning the subcommittees' acquisition of its information—"facts, incidentally, which are readily available to anyone who can read a newspaper and use a telephone directory."

He said Dechert would not even have had to use "the extensive investigative facilities and numerous intelligence experts" to find out what he wanted to know.

Moss cited Defense news releases, public statements by Defense officials, a telephone call to Defense public information officers and a phone call to the government's National Advisory Committee for Rhesus Monkey Requirements as sources of its information.

He accused Dechert of using "the Communist scare technique," called his letter "intemperate"—and repeated the request for a full explanation of the monkey business.

Warning From Stennis

Sen. John Stennis (D.-Miss.), has warned National Aeronautics and Space Administration and Advanced Research Projects Agency to show signs of progress in implementing earlier agreement to coordinate their respective satellite space vehicle tracking and data processing equipment needs to prevent unnecessary duplication of the expensive world-wide facilities. Stennis sounded the warning during last week's NASA budget hearings before the Senate Committee on Aeronautical and Space Sciences.

Horner to NASA

White House was expected to announce late last week that Richard E. Horner, 42, who has been Air Force assistant secretary for research and development since February of 1956, will become number three man at National Aeronautics and Space Administration. USAF chief scientist Dr. Joseph V. Charyk is expected to replace him.

Horner will serve as associate administrator under Administrator Keith Glennan and Deputy Administrator Hugh L. Dryden, operating as a manager for the staff that supports Glennan and Dryden. Salary is expected to be $21,500. Horner is a pilot and an aeronautical engineer. He served with USAF from 1940 to 1949 and was technical director of Air Research and Development Command's Flight Test Center at Edwards AFB from 1949 until 1955.

Army: Closed Door

Experience criteria established by National Aeronautics and Space Administration eliminated Army candidates from consideration as probable crew members in NASA's Project Mercury man-in-space program, Lt. Gen. Arthur G. Trudeau told a Senate subcommittee last week.

Testifying at a hearing of the Subcommittee on Governmental Organization for Space Sciences headed by Sen. Stuart Symington (D.-Mo.) Gen. Trudeau, Army research and development head, said the Army had 50 or 60 volunteers for the program but that he could not submit their names for consideration because one of the NASA requirements was that candidates must be graduates of test pilot schools and Army does not have such a school. Of the final seven selected, three were from the Air Force, three from the Navy and one from the Marine Corps.

—Washington staff

Discoverer II Orbital Attitude Controlled

Satellite maintained constant orientation in regard to earth until re-entry unit's ejection shifted mass.

By Richard Sweeney

Vandenberg AFB, Calif.—Discoverer II fired into polar orbit here last week recorded a substantial technical achievement when it attained a constant orientation in regard to the earth from its launch until the re-entry vehicle was automatically ejected on the 17th pass.

An achievement of this nature would be required for success of WS-117L reconnaissance satellite. The re-entry vehicle fell in northern polar areas.

The satellite, designed by Lockheed Missile and Space Division as system manager, assumed an orbit with an apogee of 243 stat. mi., a perigee of 156 stat. mi., a period of 90.84 min. and an orbital velocity of 25,570 fps. according to refined data. Thor intermediate range ballistic missile was used as first stage booster while the satellite itself was propelled into orbital velocity by an integral Bell Hustler gimbaling rocket engine.

Very shortly after second stage engine burnout, the satellite was reoriented according to preprograming and assumed a tail-first flight path. It maintained this orientation until ejection of the re-entry vehicle, when changes in configuration, and mass resulted in a different flight attitude and orbit characteristics for the satellite proper, which probably lasted but a few days after this. Original life estimates, based on first orbit information, had been about 30 days. First orbit data was for an apogee of approximately 445 mi., a perigee of 158 mi., and a period of 94.2 min.

The re-entry vehicle had been intended to eject after a command, based on refined data, was sent to the satellite from Hawaii, after which the entire vehicle would have traveled around once more before the re-entry vehicle was kicked loose. However, failure of the command system resulted in automatic ejection, according to a preset timer incorporated into the satellite.

Original timer settings were based on different orbit characteristics than were achieved, notably the period approximating 94 min., rather than 90 min.

Satellite orientation was achieved by a cold gas jet system, designed by Bendix under subcontract from Lockheed. Guidance inputs to the jets, which used nitrogen gas, were obtained from inertial reference package by Reeves Instrument Corp., and an infrared horizon scanner by American Standard's Advanced Technology Laboratories, which fed information into the guidance control loop as they ascertained deviations. Difference between sky and earth was determined by the scanner for pitch attitude while roll and yaw were derived from the inertial reference package.

A supply of gas sufficient to last more than 24 hr. was carried by the satellite in its elementary orientation system, which was designed to accomplish rough orientation for the required period of time, i.e., from launch until the re-entry vehicle was sprung loose by command or automatically. Data from the satellite on its orientation system indicated it functioned far better than personnel believed possible.

In addition, orbit characteristics themselves, the slight eccentricity required to keep the orbit active for the necessary period of time yet as close to circular as possible, and the velocity vector achieved, were close to optimized orbit figures. It had been anticipated this high quality of orbit would not be achieved until several Discoverer vehicles had been fired, if at all.

Separation

Discoverer II, at separation from the first stage, weighed approximately 8,400 lb., was 19.2 ft. long and 5 ft. in diameter. Orbital weight was about 1,600 lb. after burnout of the engine.

Bell engine fuel for this shot was unsymmetrical dimethylhydrazine while oxidizer was inhibited red fuming nitric acid, giving a better specific impulse than was obtained in first Discoverer shot where nitric acid and JP-1 were used in second stage.

Centaur Engine Firing

West Palm Beach, Fla.—First static firing of a complete Convair Centaur rocket liquid hydrogen-fueled second stage engine was scheduled for late last week or early this week at Pratt & Whitney's plant here. Accelerated testing of second stage Centaur components has been under way for several months; first stage will be an Atlas ICBM first stage engine (AW April 13, p. 35). Centaur will be able to place 8,400 lb. in a 300 mi. orbit or send 730 lb. to the moon.

Payload of the satellite weighed 440 lb., of which 245 lb. was communications, telemetry and instrumentation for measuring performance of the vehicle. The re-entry vehicle weighed 195 lb. when it separated from the satellite, and this unit again separated further down the descent trajectory, into two units—the re-entry protection equipment including retrorocket and associated structure, while second unit is the biomedical specimen capsule and its parachute, with radio beacon.

The capsule itself is 27 in. long, 33 in. in diameter. During Discoverer II flight, the capsule contained the life support systems required to sustain a biomedical specimen in orbital flight, and instrumentation was provided which constantly recorded and telemetered back data on the functioning of these systems.

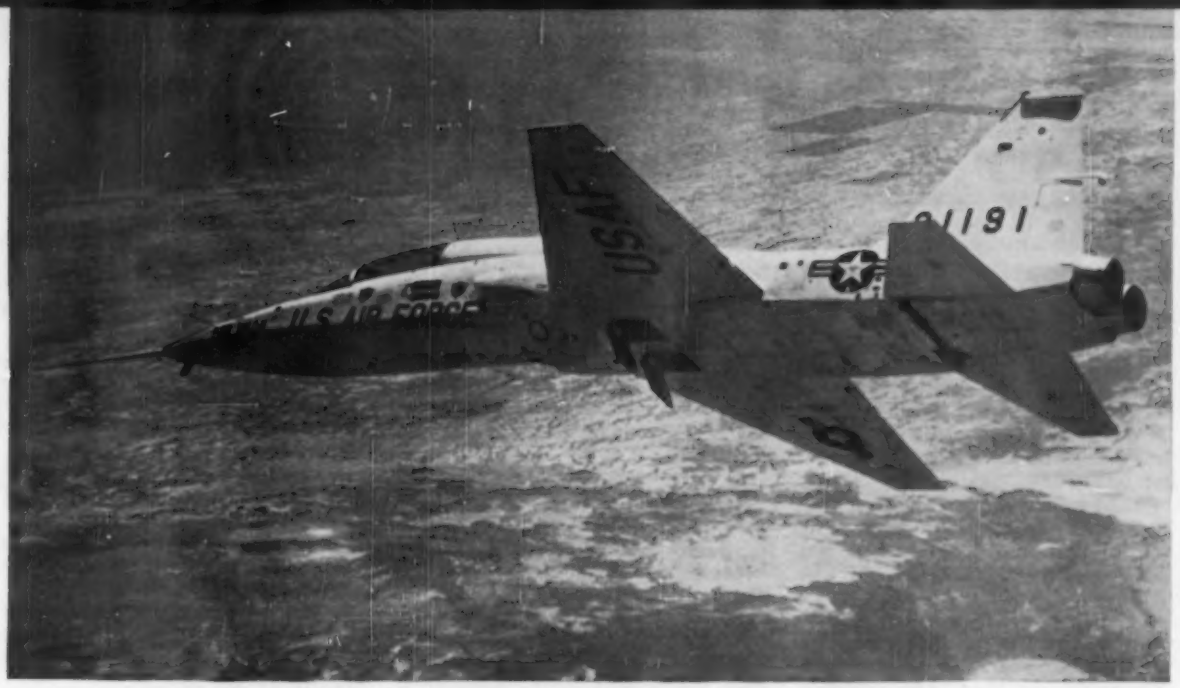
Three film packs were carried to record cosmic ray radiation in an attempt to determine the radiation's nature. Information sought was more than intensity alone; it also was hoped to ascertain the electron, proton and heavy particle content of the rays. Stable flight orientation of the satellite contributed to the validity of the experiment, which was conducted under the direction of Cambridge Research Center of Air Research and Development Command. However, it was necessary to get the capsule back to get the information, since film packs were used instead of counters and telemetry, hence results were lost with the capsule.

Navy's Pacific Missile Range functioned in the Discoverer II project in furnishing range ships USS Joe E. Mann and USS King County. The range also furnished range safety and area clearance, meteorological reports, tracking and trajectory information, high accuracy metric photos of launch, backup telemetry at Vandenberg, radar and optical tracking and telemetry services, and also reduced raw data for early launch phase.

In the launch phase, data from the Navy at Pt. Arguello and Pt. Mugu followed by tracking information from the ships, plus telemetry information from the ships, is fed back to Vandenberg where it is used in plotting.

After burnout of Thor in the launch phase, satellite was programed into a horizontal trajectory following separation from the booster. Navy Pt. Mugu and Vandenberg backup station, which also is located at Pt. Mugu, tracked the second stage through its coasting period and gave the signal to ignite the second stage for orbit injection.

Tracking stations for the satellite are



Northrop T-38 Supersonic Trainer Makes First Flight

Northrop T-38 Talon, supersonic jet trainer designed for U. S. Air Force, makes its first flight at Edwards AFB, Calif. Aircraft, which was flown by Lew Wilson, Norair Division chief engineering test pilot, is first of Northrop Corp.'s N-156F family of lightweight jet aircraft. Fighter version will fly this summer. Talon trainer is powered by two General Electric J85 turbojet engines producing about 2,500 shp. each. Takeoff weight is about 11,000 lb. Second T-38 is expected to fly next month; first aircraft will remain at Edwards AFB for flight testing. N-156F fighter version may be built overseas under license (AW Feb. 2, p. 33).

at Annette and Kodiak Islands in Alaska, and Kaena Point, Oahu, Hawaii, in addition to Vandenberg, Pt. Arguello, Pt. Mugu and the ships. The Alaska and Hawaii stations are manned by Philco personnel, and Philco also developed the ground-space communications system for Discoverer under subcontract to Lockheed.

In addition, Reeves Instrument Corp. has equipment at the radar tracking sites, while antennas at Alaska, Hawaii and Vandenberg were constructed by D. S. Kennedy & Co.

Data on flight of the satellite is computed at Lockheed Missile and Space Division's computation center at Palo Alto, Calif. Should the actual trajectory information show a difference from the planned trajectory, the Lockheed center flashes word to the tracking stations as to the new directional information.

Additional computations are conducted at Ballistic Missiles Division, where the calculations were made. When combined with Lockheed data, the decision was made to attempt to signal the re-entry vehicle to leave the parent satellite. Decision to eject was made at BMD, and order was sent to Hawaii where it was transmitted to the vehicle. Unfortunately, there already was an indication of the command malfunction and it was assumed the attempt to eject in a desired area to get the re-entry vehicle down near the Hawaii retrieving area would fail.

Definite knowledge that the re-entry vehicle did leave the satellite was gained from a telemetry channel which received information from a small switch. This switch was allowed to trip at physical separation of the re-entry vehicle and satellite, was held in place by the re-entry vehicle and could only trip when the vehicle left the satellite. BMD officials said a definite telemetry confirmation was received several times, indicating that the separation switch had tripped.

Discoverer II differed considerably from Discoverer I (AW Mar. 9, p. 323). The second satellite at separation weighed more than 8,000 lb. while first vehicle weighed about 7,100 lb. Also, after second stage burnout, the second Discoverer weighed about 1,600 lb., while first vehicle weighed about 1,450 lb.

It was learned from the first Discoverer that antennas used on the nose failed to perform satisfactorily, including a cap which was to be exploded away. Antennas were modified to conform to indications from the first Discoverer that rear antennas had worked fine, and the blowaway cap was abandoned.

Telemetry system for Discoverer II was designed by Lockheed and was capable of making more than 100 measurements of the satellite's performance. Guidance and control had 34 parameters measured; nine more dealt with the recoverable capsule, 18 dealt with engine performance for the second stage, 29 were for environmental conditions, and 15 for communications.

After the re-entry vehicle separated from the capsule, telemetry no longer functioned in this area, since power source, antennas and other parts of telemetry equipment stayed with the satellite. No information was obtained on how the re-entry vehicle and specimen capsule fared during the recovery and descent.

An announcement by Advanced Research Projects Agency said that in addition to telemetered reports, it had reports of sightings of the re-entry vehicle as well as radio contacts with the beacon.

Batteries for the satellite, capable of operating in a weightless space environment, were developed by Eagle Picher under subcontract to Lockheed, while Engineered Magnetics Division of Gulton Industries developed the static inverters, static battery voltage regulators, a.c. voltage regulator and d.c. power supply, for the satellite.

Protection during the heating period on re-entry is by means of an ablative nose cone protection system developed by General Electric Co.

NASA Reveals Mercury Pre-Orbit Plans

By Evert Clark

Washington—Twenty-six preliminary flight tests for the National Aeronautics and Space Administration's Mercury man-in-space project will include rides for each of seven pilots in Redstone-boosted capsules at 4,000 mph. over trajectories that will make them weightless for five-minute periods.

No sub-orbital flights of the Atlas with a man in the capsule will be made. First manned Atlas shot will be the first attempt to put a man into an orbit for three circuits of the earth.

Trips around the earth will range as high as 16 circuits of 90 min. each for a total flight time of 24 hr., if the program progresses as planned.

These and a number of other details of the Mercury program were reported to a subcommittee of the Senate Aeronautical and Space Sciences by National Aeronautics and Space Administration.

Details on the flight test program include:

• **Little Joe shots.** Six are planned for the last half of this year from NASA's Pilotless Aircraft Research Station at Wallops Island, Va. Four probably will test boiler plate versions of the capsule to determine behavior on re-entry and maximum load conditions. At least one will test the capsule escape rocket system, using an actual capsule. Little Joe is composed of four Thiokol Sergeant rockets clustered in a metal container with fins added. It will reach a velocity of 4,000 mph. and travel over a range of 130 mi.

• **Redstone shots.** Eight are now planned between mid-1959 and mid-1960, and it is planned eventually to let each of the seven Mercury pilots (AW April 13, p. 35) "fly" capsules boosted by Redstones from Cape Canaveral, Fla., out to a range of about 130 mi. Pilot will be subjected to high launch accelerations, five minutes of weightlessness and high re-entry accelerations. He will attempt to hold the attitude of the capsule and to change the attitude. Preceding the manned flights will be missile-capsule qualification flights and animal flights. Redstone was chosen, according to Charles W. Mathews, chief of the operations division of NASA's Space Task Group, because "it is the missile that has had the most experience behind it. It is already highly reliable and it has some very nice features from a manned operations standpoint. These fins on the back give it aerodynamic stability. It is stable all by itself during the launch, whereas the bigger vehicles depend on an automatic system to keep them stable."

• **Jupiter shots.** Only two are now on the schedule. They are to be fired approximately in the last quarter of 1959 and the first quarter of 1960. Jupiter shots will qualify the final capsule. They also may be used for animal shots. Critical condition from the load standpoint occurs at about 12,000 mph., Mathews explained. "If the capsule comes off and has to escape from the Atlas under that speed, it will re-enter at a much steeper angle than it would if it had gotten all the way into orbit and returned, and this results in the biggest load of all, about 20 g in the capsule during re-entry," Mathews said. "We can get this same condition with the Jupiter, which is a considerably cheaper missile than Atlas." Shots will be from Cape Canaveral over a 1,200 mi. range.

• **Atlas shots.** Ten boosters have been ordered thus far, for firings from the Cape beginning this summer and extending into 1961. It is hoped that the first orbital flight will come somewhere during this time period if the program goes well. Early shots will include "Big Joe" tests of boiler plate capsules fired so they will reach orbital speeds but re-enter rather than go into orbit. Hitting re-entry speeds will provide heat tests on the beryllium shield and the heat protection system for the capsule. Range will be 1,700 mi. and velocity 17,000 mph.

Animal Flights

Animal flights will prove out the environmental control system and further establish critical and stressful areas such as weightlessness and high acceleration and deceleration.

Final capsules will be double-walled titanium vessels inside a heat protection vessel, the after end of which will be a very thin high-nickel alloy that will radiate heat to space. Butt end of the capsule is joined to the heavier beryllium heat shield.

Insulation between the heat shielding and the pressure vessel will serve also as an acoustical dampening material, cutting booster sound intensity and aerodynamic noise during re-entry, and enhancing communication possibilities.

Multi-walled construction and insulation makes NASA "fairly confident there is no chance at all of a meteorite penetration," according to Maxime A. Faget, chief of the Flight Systems Division of the Space Task Group.

First Orbit

First orbital flight will proceed this way:

• **Atlas with capsule and** escape rocket system on top will be fired a little north of due East from Cape Canaveral. At 40 to 50 mi. altitude, Atlas booster engines will burn out and drop from the vehicle. Shortly afterward, the escape tower is jettisoned.

• **Once the vehicle and capsule** reach orbital velocity and altitude at about 100 naut. mi. altitude, they are separated by small rockets, and immediately the capsule is flipped over by 180 deg., so that the pilot, who has been facing forward, now faces rearward for the

Meteorological Satellite

Washington—Meteorological satellite, which National Aeronautics and Space Administration hopes to place in a 300-mi. high orbit before the end of this year, will contain three miniature television cameras for mapping the earth's cloud cover plus a variety of infrared sensors for determination of earth's heat-budget.

One of the tiny television cameras sensitive in the infrared region will sweep out a path 1,200 mi. wide and about 6,000 mi. long as the satellite orbits the earth. During one revolution around the earth, 10 overlapping pictures will be made, each with a 500-line definition which will provide ground resolution of about two and one-half miles. Two other TV cameras, sensitive in the visible region of the spectrum, will have longer focal-length optics to give cloud pictures of higher resolution over a smaller area.

The television pictures will be stored on a miniature magnetic tape recorder, then transmitted to earth at high speed during the four-minute interval when the satellite is within range of a ground station. Video signal will be recorded on magnetic tape on the ground and also displayed on a storage tube which will be photographed, making photographs of cloud cover available within minutes after the satellite has passed. Responsibility for the meteorological satellite, originally an Advanced Research Projects Agency development, has been turned over to NASA. The television cameras and associated equipment were developed by Radio Corporation of America, and the infrared sensors were designed by Army Signal Corp. Research and Development Laboratories. Air Force Cambridge Research Center and U. S. Weather Bureau will be responsible for analysis and use of the data obtained from meteorological satellite.

remainder of his flight. If the booster cannot reach orbital speed, tracking stations can trigger the retrorockets at a proper time to put the capsule down in a recovery area.

• **Pitch and yaw jets** at the small end of the capsule and roll jets at the large end are operated in response to an autopilot, which has its vertical gyro slaved to an infrared horizon scanning system that is capable of sensing the horizon even on the dark side of the earth. Jets use hydrogen peroxide to maintain the proper capsule attitude. A second set of control jets can be manually operated by the pilot after re-entry.

• **Third circuit will carry** the capsule to just north of Hawaii. A ground station there will fire the three retrorockets on the front end of the capsule. This will subtract 350 mph. from the capsule's forward velocity, and it will re-enter. Each rocket carries only 40 lb. of propellant, but one rocket is sufficient to bring the capsule out of orbit. Retropackage is jettisoned after re-entry.

• **Two windows and a periscope** plus manual control jet system will allow the pilot to help control attitude after re-entry. Small parachute opens at 60,000 ft. At 10,000 ft., a larger parachute opens. If remotely-controlled chutes fail, pilot can actuate an emergency set. Chutes are ejected after landing, which will be in the intermediate range ballistic missile impact area.

If trouble develops during the launch sequence, instrumentation on the booster or tracking instrumentation will trigger the abort system. This will fire the three rockets in the escape system, giving it 350 mph. velocity and separating the capsule from the booster by 250 ft. in the first second. After the escape rockets carry the capsule clear of the booster area, escape tower is jettisoned.

Pilot's Role

Mathews said NASA hopes that "the pilot can take a big part in this mission and thereby increase its reliability, and . . . we have equipment on board that will let him perform certain functions if we can justify his doing it." He listed examples of what a pilot may do:

• **Make scientific observations** of the stars, planets, earth's cloud cover, etc.

• **Communicate with ground stations.** Pilot will be over each station for about five minutes on each pass. Spread of the stations is such that there will be 10 mi. periods when he cannot talk.

• **Monitor equipment and** initiate emergency procedures based on an extensive training program.

• **"Fly" the capsule.** This is a back-up capability, since the capsule can be controlled remotely from takeoff to landing.

• **Navigate to the extent** that he can determine position and extrapolate position at the time retrorockets should be fired.

• **Operate back-up escape** and parachute deployment systems.

Components in the capsule have a minimum lifetime allowance of at least 48 hr., giving a possible 100% margin of safety for even the longest flight of 24 hr., USAF Brig. Gen. Don Flickinger, of NASA's Life Sciences Committee, said.

If the pilot should lose pressure inside the capsule, his USAF-developed pressure suit gives him full pressure protection and oxygen protection and adequate cooling for a full two hours, Flickinger said. Since an orbital period is only 90 min., ground controllers could bring the capsule back in within his safety period.

Sikorsky Rolls Out S-60 Crane; Future Vehicle May Lift 50 Tons

Stratford, Conn.—Sikorsky S-60, with a payload capability ranging from three tons for 100 mi. distances to an emergency, short-haul six tons, is envisioned as the first of a large flying crane family carrying suspended cargoes of up to 50 tons.

Publicly rolled out here last week a little more than nine months after work on it was first begun, the S-60 was built around the dynamic components of the Sikorsky S-56—employing the same rotor system, transmission and two 2,100 hp. Pratt & Whitney R2800 piston engines.

Development of the aircraft represents a company investment of more than $2 million. Engines for the prototype were loaned to Sikorsky by the Navy; the Army supplied some of the instrumentation. All other components and labor costs were financed by the company.

No military or commercial orders have yet been received, although both Army and Navy representatives at the rollout expressed interest in the cargo and troop carrying potential of the S-60 and its planned turbine-powered successors. Fiscal 1960 procurement funds of both services are severely limited, however.

Sikorsky comptroller Paul W. Holt said the S-60 will be made available commercially within approximately 12 months at a fly-away cost of about $750,000—$600,000 for the basic unit, another $100,000 for the powerplants and $50,000 for optional equipment, including the especially-designed hoist system.

Major features of the S-60 include the two R2800s mounted in individual pods on either side of a bridge-like boom fuselage; a glass-enclosed cockpit with room for three crewmen, and a swiveling left-hand seat in the cockpit that permits the pilot to fly the aircraft while facing backwards in order to obtain an unobstructed view of the cargo during loading and unloading. Hydraulic-electric winch system designed by Sikorsky is located directly beneath the main rotor.

Vertical clearance between the fuselage and ground is 7 ft., 8 in. Horizontal clearance between the landing gear is 19 ft., 9 in.

Sikorsky officials say the S-60 can attain a maximum speed of over 160 mph. Design cruise speed with payload, however, is approximately 100 mph. In addition to the three and six-ton loads, the S-60 is designed to carry a normal four-ton payload over a 10 mi. distance. Sikorsky officials say the aircraft also can tow a 28,000-lb. destroyer at a speed of 10 kt. over short distances.

Next planned step, and one that probably won't be taken without military backing, is the replacement of the piston engines with two General Electric 2,600 shp. T64 turbine engines.

Turbine installation in a package above the fuselage similar to that of the Sikorsky HSS-2 (AW Mar. 30, p. 30), would increase the S-60's payload by two and one-half tons and probably also provide added range, according to Sikorsky engineering manager Michael E. Gluhareff. Other modifications on the turbine design would include replacement of the present tail wheel structure with a nose wheel to provide easier access to the cargo area. Gluhareff said the T64s would be available to Sikorsky in about one year.

A 25,000-lb.-payload vehicle envisioned by Gluhareff would be powered by four Pratt & Whitney 2,900-lb.-thrust JT-12 turbojets, include two large tail rotors on separate booms and possibly up to 12 main rotor blades. Present S-60 has five main rotor blades with a 72 ft. diameter. The single tail rotor has a 15 ft. diameter.

Sikorsky has on the drawing board plans for a turbine-powered flying crane model with a 40-to-50 ton payload capacity and a gross weight of well over 200,000 lb. Present S-60 has an empty weight of 19,950 lb.; weight with fuel and crew is about 24,350 lb.

In designing the S-60, major consideration was given to complaints by pilots of conventional helicopters that it was impossible to see the cargo from the cockpit during loading and unload-

ing operations. In an effort to overcome this, Sikorsky decided upon the swivel left seat.

In operation, the pilot in the right seat flies the crane to the immediate area of the cargo and begins lowering the cable. Pilot in the left seat then unplugs his cyclic control stick, trips the seat lock, swings his chair and the attached collective pitch seat to the rear, inserts the cyclic stick into a rear receptacle and completes the loading or unloading with almost unrestricted vision. Hoist controls are located on the cyclic stick.

Jump Seat

Jump seat is located behind the right pilot's seat to carry a crewman to aid in the loading and unloading of cargo in isolated areas where there is no ground crew.

To further improve visibility, S-60 project engineer Roger Smith would like to do away with the present stick and rudder controls, replacing them with an electronic control system possibly mounted on the seat arm.

In addition to the crane, the under fuselage of the S-60 includes eight hard attachment points for securing personnel or cargo pods that may be designed in the future. Sikorsky has conducted some research and development work on pod configurations, particularly for personnel since both Army and Navy apparently believe that any helicopter they purchase must be capable of carrying men as well as cargo. Final decision as to configurations, however, probably will not be made until, and unless, a military or commercial customer states specific needs and possibly general design specifications.

During the demonstration here last week—and after successfully loading and unloading a weighted dummy of an Honest John missile and a 4,500 lb. bridge section—the winch's hydraulic system aborted while the S-60 crew was attempting to lower a 3,500 lb. utility pole into a pre-dug hole. Simultaneously, and apparently as a result of the winch malfunction, the port engine developed a hydraulic leak. The crew, however, managed to lower the pole to the ground and land without serious difficulty.

Probable reason for the failure was that a limitation switch which cuts the hoist speed from the high speed mode of 90 fpm. to the low speed of 10 fpm. was disconnected to avoid delay in loading and unloading procedures during the S-60 demonstration.

In the manual operation, and when the winch hit the stop switch at high speed, the back surge in the hydraulic system apparently blew out the hydraulic pump gasket, causing the malfunction.

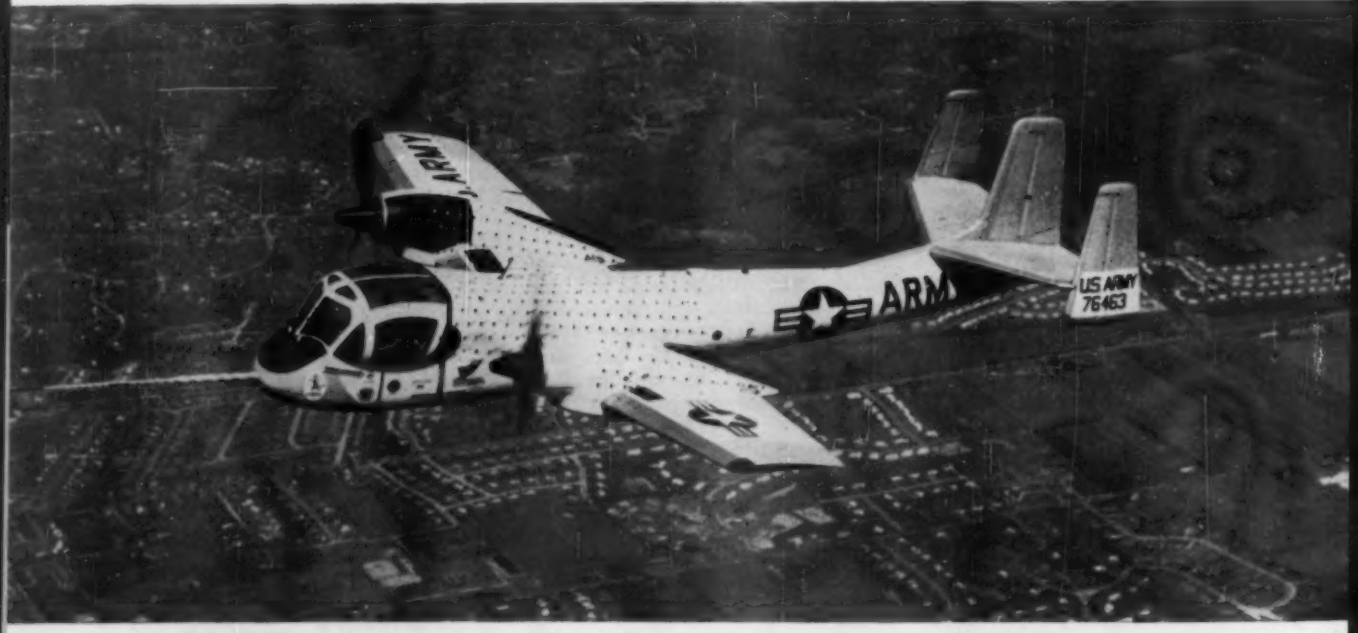
Within the system, a variable speed hydraulic pump is mounted on the left engine gearbox and geared down to 4,300 rpm. An electric control on the cyclic sticks selects the high or low speed mode of the pump, which supplies two 3,000 psi. flex lines to the hydraulic winch motor and pass through a valve. The valve, electrically controlled from the pilot controls, reverses the flow direction to obtain up or down movement of the hoist.

The pump and hydraulic winch motor are supplied by American Brake Shoe, but the entire system was designed by Sikorsky.

Hydraulic Motor

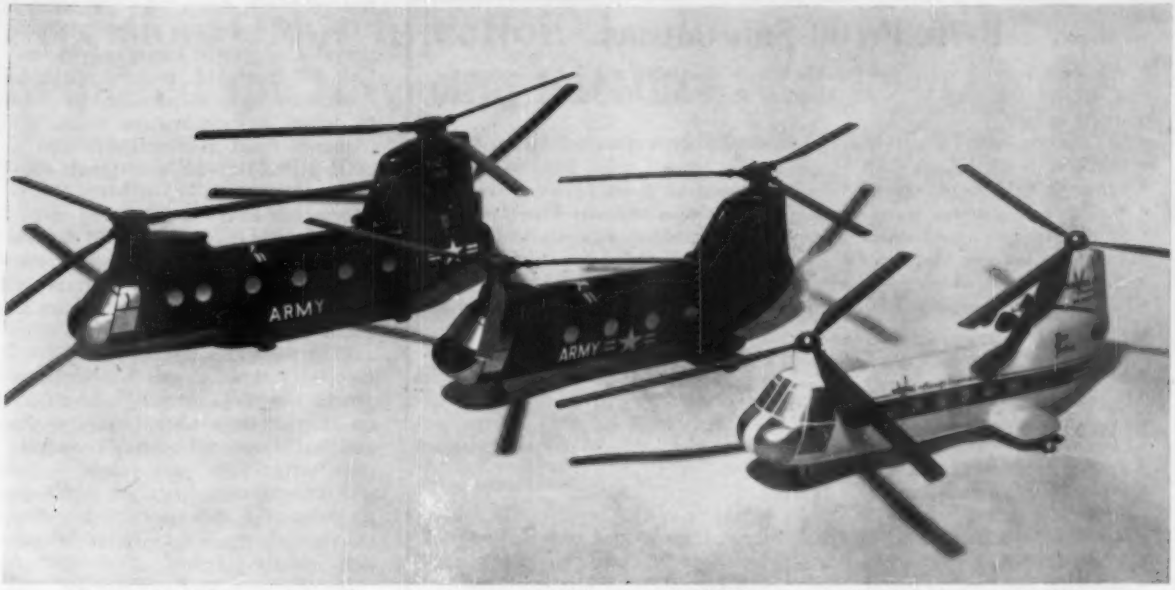
The hydraulic motor is mounted in the fuselage center section just below the rotor transmission and is geared to the cable drum. The cable itself is $\frac{7}{8}$ in. in diameter and carries the electrical connections for the Sikorsky-designed hook internally. Usable cable length is 100 ft. Hook has controls for the ground crewman to use in opening and closing. It also can be operated from the cockpit.

Structurally, the drum is supported in two castings which are tied into each side of the bottom of the wing box by vertical supports. Top of the wing box is, in turn, tied in by four supports to the transmission. Side and fore-and-aft loads are carried by four horizontal supports, two on each side of the drum.



Grumman Mohawk Starts Tests After First Flight

Grumman AO-1 Mohawk turboprop observation plane, shown on its first flight, is tufted on upper fuselage for visual inspection of aerodynamic flow pattern. STOL aircraft has a 59 kt. stall speed (AW April 13, p. 31) and is powered by two Lycoming T53-L-3 turboprop engines, developing 1,005 eshp. each. The aircraft is painted white, with high visibility paint added to triple tail. Grumman has nine prototype models under production for U. S. Army; all will be evaluated by Navy Bureau of Aeronautics which is administering Mohawk contracts for the Army. Another 35 Mohawk models, designated AO-1AF, also will be built under a follow-on contract.



Models Show Configurations of Vertol YHC-1B, YHC-1A and 107

Vertol Aircraft Corp. models show (left to right) the configurations of the Army YHC-1B and YHC-1A and their prototype, the 107. The YHC-1B Chinook (AW Mar. 9, p. 322) is a 2 to 3 ton version of the 107; the YHC-1A is a 1½ to 2 ton capacity version which is being constructed in limited numbers for Army under a contract awarded last July. The Lycoming YT53-L-1 turbine engines that power the 107 have accumulated 421 total engine hours of which 280 hr. were in flight. Seven 50-hr. YT-type engines have been used for this Vertol program. Three YHC-1s will be powered by twin T53s and seven will be powered by twin General Electric T58 turboshaft engines.

Atwood Defends Weapon System Concept

By Katherine Johnsen

Washington—J. L. Atwood, president of North American Aviation, Inc., estimated last week that weapon system contracting will cut two years lead time in development of North American's Mach 3 F-108 interceptor and B-70 bomber in testimony at hearings of the House Armed Services Investigating Subcommittee headed by Rep. Edward Hebert (D.-La.).

The subcommittee, concerned over the elimination of competition and small business in military purchasing, is making a study of procurement practices. Although there is no longer a "price" yardstick for advanced weapons, Atwood said that design competition and competition between weapon systems is still keen. In a three-day presentation to the subcommittee, he supported weapon system contracting under which one company oversees and assumes the responsibility for an entire system as "the only practical means of developing weapon systems of optimum performance that will more than match those of potential enemies in a given time period."

Atwood gave these examples of direct benefits in terms of developmental progress that are resulting from the weapon system contracting technique as applied to the F-108 and B-70 programs:

• **Compatibility of systems.** Two of the major electronic systems in the B-70 are so interconnected that between them they are able to perform a third function that otherwise would have required an additional system. "Since the two systems are provided by separate contractors," Atwood pointed out, "a high degree of cooperation and teamwork is required to ensure signal compatibility."

• **Compatibility of equipment** with operating conditions and maintenance capabilities. The outstanding example, Atwood said, is the complete electronic packaging concept being applied to both the F-108 and B-70, which provides for central location in easily accessible compartments of all electronic equipment. "Formerly, electronic systems came from the suppliers of this equipment in variously shaped black boxes that were installed at widely scattered points in the aircraft. They were not generally capable of being opened for repairs in flight, were not broken down into components that were detachable for easy replacement and were often not even located in an accessible place in the aircraft . . . under the weapon system concept, we are freed from the necessity of accepting electronic subsystems in the particular shape and form that already exist. Instead, the general design of all equipment is established at the outset to give optimum performance to the weapon system . . ."

• **Elimination of duplicative** functions. Previously, Atwood said, "it was usually impossible to avoid incorporating a certain amount of duplicatory equipment simply because it was necessary to accept so many standardized items.

"For example, the F-86D contained five gyros, each of them integral with a particular subsystem delivered to us for installation as government-furnished equipment." Through design integration made possible by weapon system

Mockup Inspection

Washington—Mockup board inspections were held last January on the Air Force-North American Mach 3 F-108 interceptor and early this month on its Mach B-70 bomber. J. L. Atwood, North American president, said that "in both instances the Air Force teams responsible for these inspections ordered only minor changes that will impose no serious problems in the development cycle.

"We are well along in our extensive manufacturing development program to perfect the many new techniques that will be necessary to produce new types of structures and utilize new types of materials."

B-70, F-108 Subcontracts

Washington—Subcontracts for the Mach 3 B-70 bomber and F-108 interceptor were detailed last week by North American President J. L. Atwood. B-70 subcontracts include:

- Air induction control system: Hamilton Standard Division of United Aircraft Corp.
- Alert pod: Beech Aircraft Corp.
- Automatic flight control system: Autonetics Division of North American Aviation.
- Auxiliary gyro platform: Sperry Gyroscope Co. Division of Sperry Rand Corp.
- Bombing-navigation and missile guidance system: Military Products Division of International Business Machines Corp.
- Engine extraction air ducting system: Solar Aircraft Co.
- Environmental control system: Hamilton Standard Division of United Aircraft Corp.
- Secondary power system: Sundstrand Aviation Division of Sundstrand Machine Tool Co.
- Horizontal stabilizer: Chance Vought Aircraft, Inc.
- Fuselage: Lockheed Aircraft Corp.
- Landing gear system: Cleveland Pneumatic Industries.
- Vertical stabilizer: Chance Vought Aircraft, Inc.
- Wing: Boeing Airplane Co.

F-108 subcontracts included:

- Air induction control system: Marquardt Aircraft Co.
- Antenna system: Electronic Specialty Co.
- Automatic flight control system: Autonetics Division of North American Aviation.
- Central air data system: AiResearch Manufacturing Division of the Garrett Corp.
- Environmental control sytem: Hamilton Standard Division of United Aircraft Corp.
- Fire control system: Hughes Aircraft Co.
- GAR-9 missile: Hughes Aircraft Co.
- Landing gear system: Cleveland Pneumatic Industries.
- Mission and traffic control system: Federal Telephone and Radio Division of International Telephone and Telegraph Corp.
- Secondary power system: Sundstrand Aviation Division of Sundstrand Machine Tool Co.
- Wing: Convair Division of General Dynamics Corp.

contracting, the B-70 and F-108 each contain only one central gyro platform and one auxiliary gyro platform. "We are finding under the weapon system contracting method many such opportunities to save weight, space and dollars by eliminating these duplications," Atwood said.

• **Common solution of operating** problems. Integrated weapon system development also makes it possible to simplify subsystems by adopting a common solution for problems that are common to several subsystems, such as vibration, Atwood told the subcommittee. "We are able to weigh the alternative advantages of providing shock mounts for an entire equipment rack, or of utilizing vibration-resistant parts and a minimum of localized shock mounts," Atwood said. "In cooperation with the equipment subcontractors, we are able to apply the solution to the various subsystems so that their built-in vibration resistance is neither more nor less than necessary."

• **Standardization of operating** requirements. As a weapon system prime contractor, Atwood told the subcommittee, North American for the first time had authority to install alternating current exclusively in the B-70 and F-108.

The result of a gradual change-over from direct to alternating current since World War II, he said, has been that some aircraft equipment has required direct current; other equipment alternating current. "We have had to install dual wiring systems at a weight penalty, and we have had to make use of inverters that have generally been a source of trouble." Complete conversion to alternating current has also permitted the use of high voltage, he reported, which, in turn, has allowed the use of miniature connectors and printed circuit flexible cables in all subsystems and made possible additional weight and space saving.

• **Cooperative testing.** Instead of each contractor separately testing his own equipment, Atwood told the congressmen, under the F-108 and B-70 programs, two or more systems are operated together and major inconsistencies ironed out before going to the expense of flight tests. In addition, he said North American has arranged for a thorough testbed program, using the Convair B-58 Hustler as the air vehicle, so that flight-testing does not have to await completion of the F-108 or B-70 prototypes. "Most major changes and modifications having to do with the compatibility of systems should already have been made by the time the first test vehicle is flown," he commented. "This telescoping of programs should permit a substantial saving in both lead-time and cost. Also, by joint testing of systems as early as possible, we hope to deliver weapon systems whose performance capabilities will not have to be impaired through unfortunate compromises."

Approximately 70% of the dollars spent on the B-70 and F-108, Atwood said, will go to companies other than North American. Thus far, there are "subcontractors to North American for major B-70 subsystems or components and 10 subcontractors for the F-108." (See box.) Atwood said North American has yet to award B-70 subcontracts on the defensive system, the mission and traffic control system, central air data system and powerplant instrumentation system, plus F-108 subcontracts on the airborne target system, radome, programer comparator and mission simulator trainer.

In addition, the Air Force has contracted directly with General Electric Co. for the engine for both aircraft, directly with International Business Machines for the bombing-navigation and missile guidance systems for the B-70 and directly with Hughes Aircraft for the missile and fire control system on the F-108.

Atwood said a total of 190 bids were received for the major B-70 and F-108 subsystem subcontracts.

To illustrate the extent to which the B-70 and F-108 programs will be spread throughout the industrial and economic structure, Atwood estimated that eventually 20,000 companies will be involved in the various tiers of subcontracting. He also predicted that 60,000 would be employed in the program by firms other than North American at the time of peak effort.

Since the advanced technical nature of the B-70 and F-108 subsystems dictated that they be subcontracted to large companies, Atwood said North American has exerted "greater efforts" to assure the participation of small business through the other tiers of subcontracting. Steps the company has taken include:

• **Appointment of a new** full-time corporate small business administrator "with the sole and express function of carrying out the company's expanded small business program."

• **Appointment of new small business** administrators at each North American division. With a level of responsibility equal to that of the chief purchasing agent, Atwood said, "they are thus separated from the control of the buying authority but are able to coordinate their efforts with it and with the other functions under the division director of material."

Precision Orbit Injection Angle Required for Hovering Satellite

Washington—Orbit injection angle must be controlled to within at least 0.1 deg. and injection velocity to within 0.01% to place a 24-hr. (hovering) satellite into orbit at 23,000 mi., an order of magnitude better than accuracies now required for conventional satellites, John P. Clayborne told the Senate Aeronautical and Space Sciences Committee during recent hearings. Clayborne is technical assistant to the director of Redstone Arsenal's Guidance and Control Laboratory.

Even with the best injection guidance obtainable, the satellite probably will drift slightly, requiring modest velocity changes after it is in orbit at approximately 23,000 mi. altitude, Clayborne said. He said a satellite drift of one degree per year is a very challenging target to shoot for.

These accuracies could be obtained with existing radio and inertial guidance techniques, but present booster payload limitations prevent their use today in the final stage where the precise guidance accuracy is required, Clayborne said.

Progress in design of smaller and lighter guidance packages coupled with larger rocket engines should permit use of final-stage guidance, Clayborne said. Such vehicles are now in the advanced stages of development.

Attitude control of satellites initially will use jet nozzles, but a more advanced technique, presumably under development, will employ reaction flywheels, powered by solar cells.

Gyroscope bearing with practically no friction, which would enable them to operate continuously for a year, appear possible through application of cryogenics (extremely low temperatures), Clayborne said.

Midcourse Guidance

Self-contained stellar-inertial system has one important advantage over earth-based radio guidance for midcourse navigation in interplanetary probes, Benjamin Milwitzky, head of the geodetic and navigation program at National Aeronautics and Space Administration, told the Senate Committee. This is because stellar-inertial system operates in terms of angles between planet, whereas an earth-based radio guidance system must use distances between planets in its calculations. The angles involved are known more accurately than the distances between planets, Milwitzky said.

Terminal guidance for making planet-fall may be provided by optical or infrared horizon-scanner which establishes line of demarcation between surface of planet and space beyond. The device also can be used to give rough indication of vehicle's distance from the planet by means of stadiometric ranging technique and approximate direction of planet's vertical. For final phases of planet approach, a radio/radar altimeter probably would be used.

Milwitzky said that work currently is under way at NASA to come up with a program leading to the development of operating hardware for midcourse and terminal guidance.

Communications

In describing some of the problems of transmitting data back to earth from a space vehicle over distances measured in millions of miles, Leonard Jaffe, chief of NASA's communications satellite program, pointed out that up to 10 million times as much power is required to transmit a television picture from a space vehicle back to earth as is needed for narrow-band telemetry signal.

Voice transmission requires up to 10,000 times more power than for narrow-band data telemetry.

Because of secondary power limitations in early space vehicles, Jaffe suggested that a single-frame TV picture would be stored on magnetic tape or drum, then transmitted back to earth by means of narrow-band transmission requiring only low power.

Low-frequency radio transmissions have an advantage over VHF and UHF for transmission of data through space, Jaffe said, but these frequencies cannot penetrate earth's ionosphere. This limitation could be overcome through use of a satellite relay system which would orbit above ionosphere, receive space vehicle's low-frequency transmissions and rebroadcast them to earth at a higher frequency that would penetrate the ionosphere. However, this is "quite a ways in the future," Jaffe said.

By 1960, Jaffe said, the U.S. must have capability of communicating over inter-planetary distances of approximately 40 million mi., by 1962, throughout the solar system. This, he said, will require the development of steerable, directional antennas for space vehicles, high-powered ground transmitters and extremely large antennas, and high-efficiency transistors to make maximum use of limited secondary power available aboard a space vehicle.

Mirage 4 Details

Paris—Dassault Mirage 4 twin-turbojet Mach 2 bomber last week was being readied for its first flight. French Air Ministry said the aircraft, development vehicle for a larger Mach 3 bomber (AW Feb. 9, p. 23) will have a 937 mi. range and will be powered by two Snecma Atar 9 turbojet engines. Armament has not been disclosed but observers here contend the aircraft is designed to carry air-to-ground missiles with nuclear warheads.

Ministry also revealed that the 100,000 lb. Mach 3 bomber will have a 1,250-1,875 mi. range with in-flight refueling capability. Engines probably will be Pratt & Whitney J75 turbojets built by Snecma under license. First flight will be in the spring of 1961.

Attack System May Use Nuclear Ramjet

Las Vegas—Strategic low altitude attack system designated Project Slam and based on the use of nuclear ramjet power has been outlined by three aircraft companies in studies conducted for Air Research and Development Command.

Project Slam involves a weapon system concept oriented toward use of the nuclear-powered ramjet engines the Atomic Energy Commission is studying under Project Pluto. Project Slam studies have been completed for the Air Force by Convair's San Diego Division, Chance Vought Aircraft, Inc., and North American Aviation's Missiles Division (AW April 6, p. 37).

Nuclear ramjet weapon system would be a supersonic, low altitude missile which could penetrate enemy areas at altitudes under 10,000 ft., creating a nearly impossible defense problem for radar warning nets which must also handle high level bomber attacks and cope with ballistic missile attacks (AW Mar. 2, p. 38).

The nuclear ramjet-powered missile would be lifted to ramjet operating speed by boosters, then could cruise over extremely long ranges at supersonic speeds. Although the cylindrical body of such a vehicle could provide sufficient lift at supersonic speeds to eliminate wings, the missile would have some kind of control surfaces. With practically unlimited range and with control capabilities, such a missile could fly varying courses in an attack and could conceivably be called back after being launched at a target.

With its range, controllability and ability to make supersonic penetrations at very low levels, a nuclear ramjet-powered missile could add considerable flexibility to a future strategic attack system built around intercontinental ballistic missiles and high altitude bombers.

U.S. Engine Reaches Million lb. Thrust

New York—Single chamber 1.5 million lb. thrust engine now under development by Rocketdyne Division of North American Aviation has been fired successfully, producing more than one million lb. of thrust. Initial development was begun less than a year ago.

Maj. Gen. Marvin C. Demler, Air Force deputy chief of staff for development, reported the firing in a speech to the Metropolitan Section of the Institute of Aeronautical Sciences, calling it "rather spectacular" progress.

The engine was conceived by USAF in 1955 and preliminary design was completed in December of that year, Gen. Demler said. Although basic design data was available, lack of dollar support kept active development from being started.

"As we learned more from the 400,000 lb. thrust engine, the possibilities of the million lb. rocket became more evident and feasible," Demler said. Less than a year ago, USAF contracted with Rocketdyne for initial phases of development. Late in 1958, National Aeronautics and Space Administration took over the program and contracted with Rocketdyne for development. Gen. Demler called the first firing in early March "a significant step forward on the part of both industry and the government."

In Washington, a NASA witness told a congressional hearing that the 1.5 million lb. single chamber engine will generate an estimated 70,000 hp. of noise, compared to about 200 hp. of noise generated by current jet engines.

The other 1.5 million lb. thrust engine now under development, a cluster of eight Rocketdyne 150,000 lb. engines, now is scheduled to be static fired at Army Ballistic Missile Agency's Redstone test stand next Dec. 5. First launching from Cape Canaveral, Fla., is estimated about July of next year.

Commerce Plans Electronic Survey

Washington—First comprehensive survey of defense and industrial electronic end-equipment manufacturers to determine annual sales volume, backlog, inventories and other data needed by government mobilization planners, is being launched this week by Commerce Department. Survey results also are expected to be of considerable value to industry marketing and planning personnel.

Survey questionnaires are being sent to approximately 550 companies who produce electronic end-equipments and a similar survey is going out to 150 manufacturers of microwave components. Survey is aimed primarily at obtaining data on defense electronic equipment, avionic equipment for nonmilitary use, and industrial communications.

Survey will not include consumer goods (radio, TV), medical electronics such as X-ray machines, broadcast station equipment or computers/data processing equipment, except for computers used as part of a military weapon system. Many of the excluded items already are covered by data gathered by Electronic Industries Assn. or other trade groups.

Manufacturers will be asked to provide data only on equipments which they sell to the ultimate user—the government, airlines, etc. and to exclude systems, subsystems and assemblies sold to other manufacturers for incorporation as elements in the latter's equipment. Purpose is to avoid multiple-counting of the same item at each subcontractor level with consequent false industry figures.

Survey will provide more than 100 different end-equipment categories. In the field of components, considerable data already is available from EIA and other sources on manufacturers of tubes, transistors and other basic components.

News Digest

McDonnell RF-101 Voodoo reconnaissance plane flown by Air Force Capt. George A. Edwards, Jr., set an official world's speed record over a measured 500 km. closed circuit course of 816.279 mph. last week at Edwards AFB, Calif. Former record of 695.127 for the course was set in July, 1955, by a Navy-Douglas A4D-1. Flight, covering a total of 321 mi., was made official by the Federation Aeronautique Internationale.

Argus experiment's scientific findings will be discussed by Nicholas Christofilos on the afternoon of April 29 at the National Academy of Sciences Auditorium in Washington, D. C., at the first session of a Symposium on Problems in Space Exploration. Session is part of a joint Academy-American Physical Society-National Aeronautics and Space Administration meeting that begins on April 27.

First D model of the USAF-Convair Atlas was destroyed last week after a hold-down arm failed to release properly, damaging the glass fiber skirt of the base of the missile and causing it to leave the launch pad at an angle some 30 deg. off the vertical. Missile kept attempting to right itself but again tipped to an angle some 15 or 20 deg. off the vertical and finally was destroyed at a very low altitude by range safety officer.

National Aeronautical Corp. (Narco) has won Federal Aviation Agency competition to develop lightweight, low-cost distance measuring equipment (DME-T) for general aviation use. Equipment is expected to sell for less than $1,500, weigh less than 25 lb., be accurate to within 3% at distances out to 100 mi. First prototype equipment is slated for delivery within 11 months.

Air Force announced the selection last week of AC Spark Plug Division of General Motors to produce inertial guidance systems for its Titan intercontinental ballistic missile. Other contenders in Air Force competition included Kearfott, Minneapolis-Honeywell, Northrop's Nortronics Division and Sperry Gyroscope Co.

Hughes Model 269A two-man helicopter (Army YHO-2HU) has been type certificated by Federal Aviation Agency.

Electric Boat Division of General Dynamics Corp. will launch first submarine designed as a Polaris launching platform on June 9. The nuclear-powered George Washington SSB(N)598 has vertical tubes for firing Polaris, plus torpedo tubes for attacking enemy ships and submarines.

Beech Aircraft Corp. has received a $1 million USAF contract for construction of a transient heat laboratory at Boulder, Colo., to simulate thermal conditions of space flight. Laboratory will ground-test effect of high temperatures on prototype rocket and space vehicle propellant systems.

Douglas Losses

Douglas Aircraft Corp.'s first quarter net loss of $4,208,145, the first deficit the company has shown since 1947, resulted from a combination of heavy DC-8 jet transport write downs of $17 million at a time of tapering military and commercial sales.

Though these write offs will decline during the year, they will continue to affect earnings adversely and Chairman Donald Douglas, Sr., told stockholders last week he did not expect the company to show any profit this year. Among projects disclosed at the annual meeting is an off-the-shelf cargo DC-8 now in production using a Pratt & Whitney JT3 turbofan engine.

First quarter sales dropped from $312 million a year ago to $227 million. Last year the company showed a net profit of $8.5 million in the first quarter.

The Douglas DC-8 Jetliner alongside the specially designed Shell jet fuel truck.

AeroShell Turbine Fuel powers another great jet airliner

THIS MIGHTY GIANT of the Jet Age...The Douglas DC-8—will be America's newest jet airliner in passenger service this year. It is able to carry up to 176 passengers in smooth, quiet comfort.

Ready to serve *all* these new jets is AeroShell Turbine Fuel developed especially by Shell to meet the exacting fuel requirements of this new Jet Era.

Shell . . . the largest supplier of commercial jet fuel and aviation gasoline in the U. S. A . . . guards the quality of these fuels by special handling techniques, developed in Shell's unique AeroShell Turbine Fuel Equipment Laboratory.

WRITE FOR FREE LEAFLET

"FUELING THE DC-8"

This step-by-step picture story shows how the DC-8 is refueled.

SHELL OIL COMPANY

50 WEST 50th STREET, NEW YORK 20, N. Y.
100 BUSH STREET, SAN FRANCISCO 6, CALIF.

SHELL

F-108, NUCLEAR TURBOJET, AND RAMJET PROJECTS OFFER CHALLENGING OPPORTUNITIES TO PROFESSIONAL ENGINEERS AND SCIENTISTS

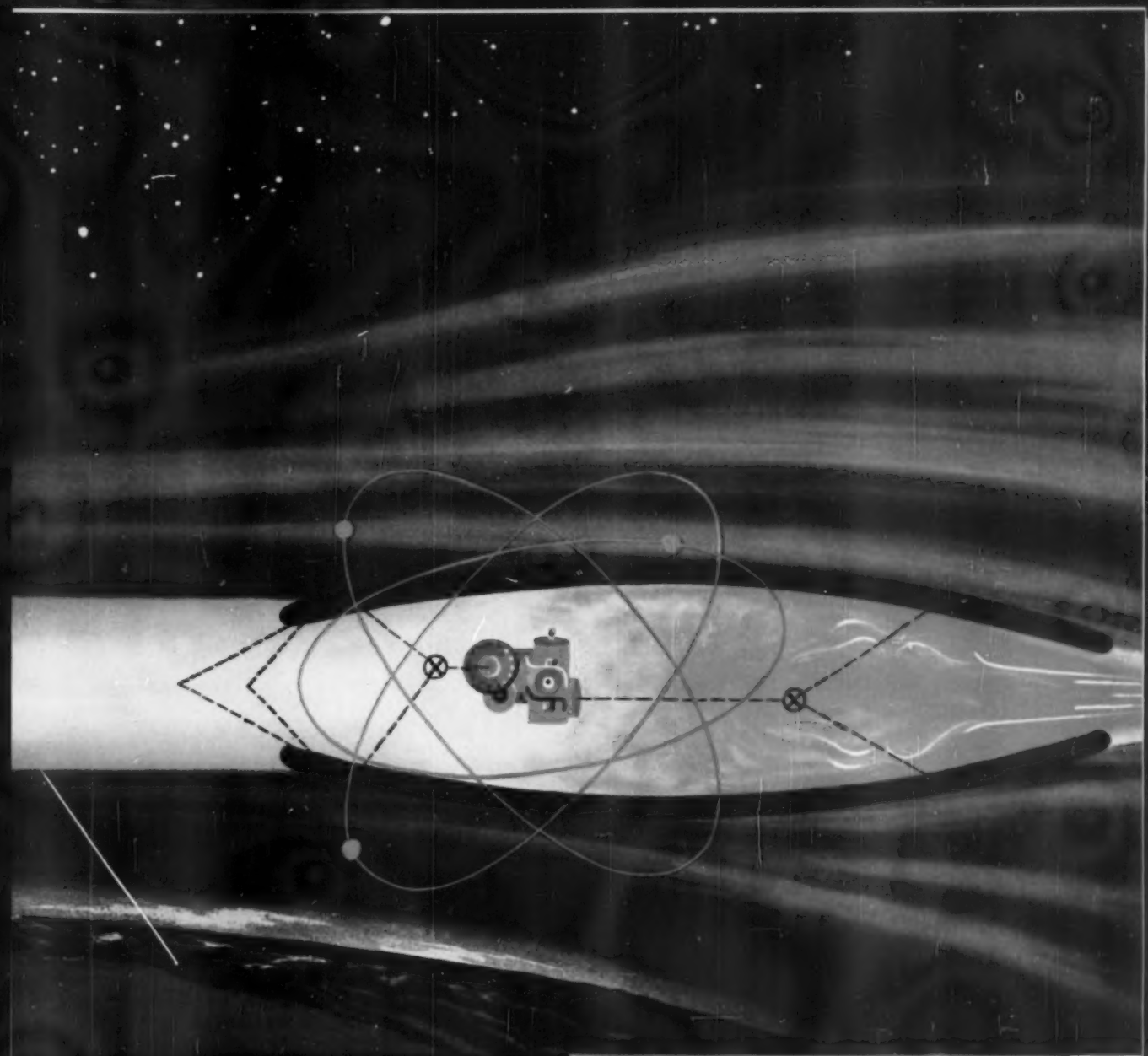
Advanced projects for air and space operations now underway in the Controls and Accessories Division at Marquardt Aircraft offer engineers and scientists challenging opportunities in a variety of technical areas. Here, where we are dealing with development problems on high-performance systems with stringent design and reliability requirements, professional engineers will find real challenge and opportunity for accomplishment.

Project personnel are currently working in such areas as the engine control system for the G-E nuclear turbojet; inlet control systems for the McDonnell F-4H, North American F-108 and the North American Hound Dog missile; the fuel control system for the supersonic Bomarc's ramjet engine; auxiliary power systems, pumps, and actuators; and are developing a unique and advanced space power unit.

C & A Division activities range in scope from preliminary design through final production.

Professional engineers and scientists capable of making contributions in these and related areas are invited to investigate the employment opportunities at Marquardt. You will find a combination of significant, active projects and a lively interest in new ideas, creating an environment for professional growth. May I suggest you write Mr. Floyd Hargiss, Professional Personnel Department, 16551 Saticoy Street, Van Nuys, California?

Roy E. Marquardt, *President*



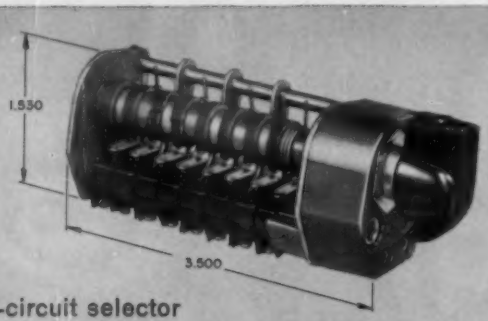
◄ C & A Division engineers made many contributions to the "state of the art" when they developed the fuel control system for the supersonic ramjet engine.

Marquardt
AIRCRAFT CO.

VAN NUYS AND POMONA, CALIFORNIA—OGDEN, UTAH

A toggle switch that mounts in ¼ sq. in.

2TM1-T weighs 4½ grams. Ideal for use with printed and transistorized circuits and compact communication equipment. Operates dependably from −65° to +200° F. DPDT. Data Sheet 158.



8-circuit selector switch mounts in less than 1.75" dia.

"28AS" series switches have 2 to 4 positions, can control up to 8 circuits. Enclosed SPDT contacts, positive non-tease detents, sealed actuating mechanism. For aircraft, electronic and computer instrument panels. Data Sheet 162.

An ideal starter switch for aircraft and autopilot use

5ET1-6 is a completely sealed, momentary-action toggle switch which can be "electrically held" by means of a built-in solenoid. This permits remote electrical release of the lever. Switch can be manually overridden. Meets immersion test requirement of MIL-E-5272A. Wire leads conform to MIL-W-5086. Data Sheet 121.

A small, positive-locking, 3-position toggle switch

13AT2-A. Compact, pull-to-unlock toggle switch requires minimum behind-panel space. Widely used on airplane control panels, navigation systems and missile pad controls. Requires pull of .090 in. to unlock. Two SPDT basic switches shown. Data Sheet 160.

4 NEW precision switches meet a variety of specific aircraft and missile applications

Only at MICRO SWITCH does the designer of aircraft and missiles find such a wide variety of small size, lightweight, extremely reliable switches engineered to meet present and future needs.

MICRO SWITCH specialists work in close cooperation with the aircraft and missile industry . . . know what the requirements are and will be . . . and new switches are always in process of development and test.

Consult with MICRO SWITCH engineers experienced in switches for aircraft and missiles at any branch office. It can save you time and money.

MICRO SWITCH . . . FREEPORT, ILLINOIS
A division of Honeywell
In Canada: Honeywell Controls Limited, Toronto 17, Ontario

Honeywell
MICRO SWITCH Precision Switches

Domestic Traffic May Hit Record Year

Best first quarter volume in history strengthens confidence in $3 billion re-equipment program.

Washington—Domestic airline business, off to a healthy start with the highest first quarter traffic volume in history, now appears headed for a record year.

The recent upsurge in traffic, following a dismal 18 months of recession, has created an atmosphere of optimism and is strengthening industry confidence in its $3 billion re-equipment program. Behind the rosy outlook, however, lies the fact that the majority of carriers have been unable to arrest the mounting expense level which threatens to outstrip revenues and continue the squeeze on profit margins.

The industry's ability to finance its entry into widescale turbine operations hinges upon increased profits as a major factor in raising funds to supplement long-term loans. Most carriers will be forced to turn to equity financing, retained earnings and proceeds from the sale of old equipment in order to cover completely transitional costs for the turboprop and turbojet equipment.

Nevertheless, traffic during the first three months of 1959 points to a new period of prosperity for the domestic trunkline industry and a restoration of the historic growth pattern that came to a virtual halt beginning in mid-1957.

Passenger revenue miles for the three months reached 6.25 billion as compared with 5.79 billion for the same period of last year and 5.61 billion in 1957. Gain for the month of March alone was 14.4%, the largest increase recorded in this category in the last 14 months.

Load Increases

Total trunkline load factor for the month of March climbed to 60.4% compared to 58.5% in March of last year. Load factor increases have been registered in only 12 of the past 39 months.

The marked rise in traffic was reflected in a sharp jump in available seat miles as carriers increased schedules to grab their shares of the new spurts of traffic. Available seat miles, which seldom begins to show a large increase until the relatively busy months of May and June during the course of a year, hit an all-time monthly high of 3.79 billion in March, an 11% increase over the previous March.

Total for the first three months, which includes 23 days of strike shutdowns against Eastern and American, reached 10.5 billion available seat miles, an increase of 1.3 billion over last year's first quarter.

Typical of the accompanying climb in traffic with the increase in available seat miles is the experience of Northeast Airlines on its Boston-New York-Washington route. During the first three months of 1959, the airline carried a total of 65,000 passengers in and out of Washington as compared with the 30,000 handled at Washington by the airline in 1957, the first full year of service on the route.

A total of 105,000 passengers were transported in and out of Washington during the entire year of 1958. Introduction of Viscount service in August is held by carrier officials as the chief reason for the sharp jump in traffic. The airline now operates five Washington-Boston nonstops and seven Washington-New York-Boston flights daily as compared with the five Convair flights operated over the route in 1957.

Domestic coach traffic showed the biggest gain in the trunkline industry with the 12 carriers handling a total of 2.62 billion revenue passenger coach miles during the first quarter. February coach revenue passenger miles increased 24% over the previous February while March showed a 26% increase in revenue passenger miles.

To meet this demand, the airlines made a substantial increase in coach available seat miles, leaving first-class available seat miles at a relatively stable level. As of March, coach available seat miles for the 12 months to date showed a 12% increase as compared with 3.8% decrease for first-class available seat miles.

Coach load factors moved to 62.26% in March from a February load factor of 57.66%.

The first-class load factor climbed from 57.76% in February to 59.11% in March.

Load factors in both categories during the past three years have consistently declined. However, the drop in coach load factors was greater than first-class until the first quarter of this year when recovery of the coach group has been almost double the first-class figure.

Although coach load factors fell more sharply than first-class load factors, coach revenue passenger miles reacted less violently to the general economic recession last year than did first-class traffic which is made up largely of expense account and official travel.

This apparent anomaly is due to the steady increase in coach available seat miles throughout 1958 and a consistent decline of first-class available seat miles in the same period. Last year's experience has emphasized to a number of airline officials the significant role air-coach travel has taken as a dependable and continuing source of revenue since it was introduced in 1949.

The 1958 experience also contradicts earlier theories that coach traffic would be the first type to disintegrate during a depression or a setback in the general economy.

New Markets

Most carriers now expect that turbojet and turboprop equipment will attract new traffic and open new markets for the industry. Degree to which the turbine-powered aircraft will increase traffic volume is still speculative. However, experiences of American Airlines, with its Boeing 707-120s, and United Air Lines, a direct competitor on the transcontinental routes where the Boeings operate, bear out any optimism the industry may have in this respect.

With its three New York-Los Angeles turbojet flights and one New York-Chicago-San Francisco turbojet flight, American Airlines reports a 95% load factor since service began last January. During the first 12 days of this month, load factor on all four flights exceeded 96%.

Load factor on the Lockheed Electra between New York and Chicago has held to a steady 80%.

United, however, suffered no traffic declines as a result of the turbojet competition. For the first quarter of the year, United reported an all-time high for three months in the first quarter of 1959. During the period, traffic volume climbed 12% over the same period last year.

Revenue passenger miles for the airline in March rose 5% from the same month a year ago and revenue airplane miles moved up 6%.

United President W. A. Patterson attributed the increase to an improvement in the economy and "the gradu-

ally heavier use of air travel for business reasons."

Records of the two carriers on the highly competitive transcontinental route indicate there is no immediate trend toward market saturation, a possibility that loomed ominously during 1958, and that the turbojet equipment may well be luring traffic away from other media.

Northwest Airlines showed an increase of close to 60% in revenue passenger miles in March compared to March of last year. Part of the increase is considered due to the new Florida route the airline inaugurated in December but—according to Donald W. Nyrop, Northwest's president—"passenger boardings have increased significantly in many cities Northwest serves."

For example, depression-hit Detroit showed a 42% traffic increase in March compared to the same month last year. Pittsburgh traffic was up 47%, Washington 49%, New York 40% and Milwaukee 44%.

Delta Air Lines reported an 11.45% increase in revenue passenger miles flown on its domestic routes during the first quarter. The quarter, according to C. E. Woolman, Delta president, "is the second highest quarterly volume in our history, exceeded only by the 409 million revenue passenger miles flown in the December, 1958, quarter when certain of our competitors were grounded by strikes."

American Airlines' revenue passenger miles increased 8.8% in March over the same month last year but revenue passenger miles dipped 9.4% during the first quarter from 1.57 billion last year to 1.03 billion this year.

The decline was attributed by American President C. R. Smith to the pilots' strike which grounded the airline from Dec. 19 to Jan. 11. As a result of the traffic decline, the airline reported a net loss of $1.9 million for the quarter exclusive of a gain on the sale of property totaling $1.1 million.

Gross revenues during the first quarter dropped to $69.5 million from $71 million reported during the first three months of last year. The airline estimates that the gross would have reached $79 million but for the strike.

United Air Lines expects to report a profit for the first quarter compared to a loss last year for the period.

Cargo and freight traffic handled during the first quarter indicated a promising trend. American Airlines reported a 13% increase in airfreight in March and a .3% increase for the first quarter in contrast to the passenger traffic decline. United registered a 34% climb in airfreight during March over the same month last year.

Flying Tiger Line had a 32% cargo increase in March—second highest month on company record.

Cherington Foresees Airline

Las Vegas—Domestic fares will be driven downward in 1961 as carriers compete intensely to keep their turbine transports full, Paul W. Cherington of Harvard University reported last week at the First World Congress of Flight attended here by more than 3,000 representatives of the U.S. and foreign aviation interests.

The week-long series of formal talks, air shows and equipment displays was sponsored by Air Force Assn., which considers it an expanded version of the annual Jet Age Conferences held in Washington in the past three years.

Because little has been done in the area of attracting new markets to the airlines, Cherington estimated that starting in 1961 there will be a trend to reduced fare services and a rise in fare cutting. This shift will be the result of "the competitive frustration of some of the weaker carriers and the necessity of their maintaining utilization and load factors on the jets."

The trend won't invalidate the 1958 domestic trunk fare increase in Cherington's view, but it will indicate that the carriers have done a poor job of following up the increase with more aggressive and more imaginative marketing. Admitting that the competitive picture arising from jet delivery dates is still confused, he insisted that the future in the jet age belongs to the airlines which can get ready for a marketing breakthrough in terms of new market identification, new sales and advertising approaches and new pricing techniques.

Domestic airline traffic has resumed its growth this year and is increasing at the rate of about 11%, and the few jets in service have been greeted enthusiastically by passengers.

But traffic must grow faster "unless we are willing to have load factors drop into the low fifties by 1961-62, or unless we are willing to see the return to fare cutting such as went on in the period of 1948-49," he emphasized.

Warning that it is already late to be starting such an effort, Cherington said that only a handful of carriers have taken any aggressive action in the past year to search out new potential markets or to re-examine their selling techniques.

Airlines apparently overlook the enormous travel potential of families with incomes of $8,000-$10,000 who now spend their money on other things, he said. A modest shift in upper-income family spending patterns would generate substantial traffic, "but it will almost certainly not take place by itself. There is simply too much competition for the consumer's dollar," he added.

In another talk, Sir William Hildred, Director General of International Air Transport Assn., based a prediction of lower international fares on the potential efficiency of the jets, pointing out that they came along at a point when the fare-cutting potential of piston aircraft had about reached its limit. He admitted that definitive data on jet operations costs is lacking, but he said this summer's operations should clear up the cost picture. And right now, lower seat mile costs are the prospect.

Calling the recently imposed jet surcharge "small and highly temporary," Sir William said the carriers must get passenger fares down, noting that similar cuts in cargo rates also will be necessary to fill turbine transport cargo holds.

Ground Services

In a discussion of airline ground services, Cherington said that such functions as reservations and ground transportation will have to be re-integrated into a more sensible system, and the job will require some major replanning of airline functions over the next few years. He suggested that the carriers could confine operations to handling the passenger only from terminal gate to terminal gate, or they could expand their scope to include ground transport and "some new and better ways of handling tickets, reservations, baggage and other appurtenances on an air journey."

Ground service problems will become increasingly intense and question is whether the airlines will be willing to face up to them. He said a closely related problem is the question of whether regulatory authorities will recognize the need for new solutions and will cooperate by making it possible for the carriers to attract required financial and other resources.

In recent years, the military services have turned to a systems approach in developing new weapons which integrates support equipment, logistics support and personnel with the weapon itself, and Cherington said it is "high time a similar approach is taken in air transportation."

Upward trend in the scale of trunkline operations can be expected to lead to mergers over the next few years, he said, and while the regulatory process can retard this movement, it is not likely to stop it. Despite the fact that the Civil Aeronautics Board has been trying to build up the smaller trunklines, Cherington said there is some danger the jets will make it impossible for some of them to compete in an effective manner.

Along with this trend to bigness,

Fare Cuts

Cherington sees the aging of top airline management as another factor which will encourage mergers. The average age of trunkline chief executives is 58. Of the 12, seven are 59 or more, and only one is under 50. "Thus it may be easier for some of these gentlemen to face the possibility of merger with equanimity," he said.

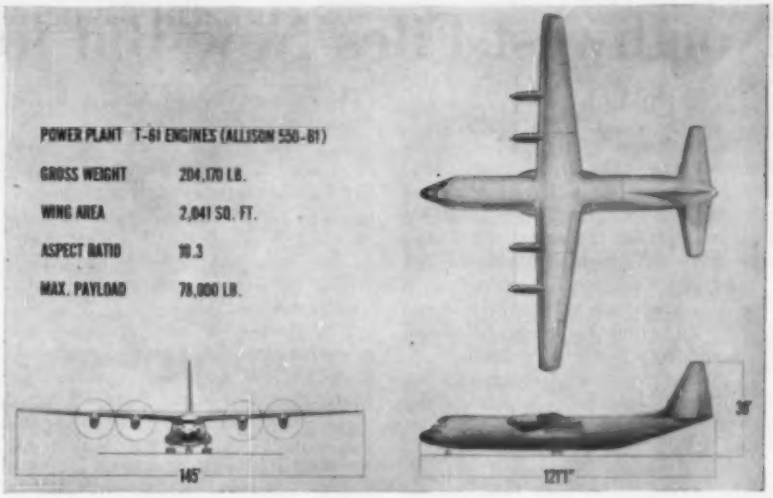
Ability to attract the necessary management talent in coming years may be an important factor in attracting financial resources, Cherington said. In due course, top management men will have to be replaced, and this fact throws the spotlight on the quality and depth of management just below the top. Observing that some carriers are going to have to pay more attention to this situation in the immediate future, Cherington said the jet age "is not likely to be a happy experience for carriers with a DC-3 team of executive talent."

As for the financial resources the airlines will have to command over the coming years, Cherington previously cast doubt on the ability of some carriers to arrange it successfully, although with economic recovery, the industry as a whole seems to have met this challenge for now. Cash throw-offs from current investments will provide substantial sums for either a second round of equipment buying in the 1962-65 period or for purchase of supersonic transports in the last half of the decade.

With reasonable earnings, Cherington feels the trunk industry should be able to finance aircraft equipment programs over the next few years without too much trouble, but an expansion of the scope of airline service could drastically alter this picture. In such a case, the financial problem would again become serious, he said, particularly in view of the present general attitude of institutional lenders.

Right now, these large scale investors have the impression that the large airlines are here to stay, there is some uncertainty about the middle-size carriers and there is real doubt about the smaller ones, according to Cherington. Coupled with the fact that relatively few persons in the financial community are really knowledgeable about airline economics and operations, this image creates a serious problem for the middle size and smaller carriers.

Cherington said this image can be blamed partly on the carriers themselves because they have frequently approached investors with poorly supported prospectuses "and with a somewhat arrogant and truculent attitude." Part of the fault also lies in the failure of the financial community to explore the economic facts of a rapidly growing industry, he said. "Almost certainly, the carriers both individually and as a group have a major educational job to do among institutional investors over the next few years."



LOCKHEED Super Hercules version of the C-130 turboprop transport, unveiled at World Congress of Flight at Las Vegas, will be capable of carrying 32,000 of cargo nonstop for 5,500 mi. using pylon fuel tanks. Maximum cruise speed will be 425 mph. As troop carrier it will airlift 152 troops. Stretched version will be 23 ft. 4 in. longer; wing span will be 14 ft. 5 in. longer. Allison T61 engines developed 5,500 eshp. each.

American Seeks Equity

American Airlines' expected step to broaden its equity base (AW April 6, p. 49) was taken last week with the authorization by the board of directors of private sale of $40 million in subordinated convertible debentures bearing 5% interest and convertible into common stock at $35 a share.

American also will place a $30 million 5% note, privately, probably with an insurance company or institutional source. American has borrowed $50 million of a $75 million 4% promissory note arranged in 1955. It still has available for borrowing $85 million from this note and a 4¼% $60 million note arranged in 1956.

The new borrowings are specified for general corporate use rather than specifically for jet equipment financing. The rise in airline stock prices rather than absolute need at the moment probably was the reason for American to decide on the equity issue. American stock was selling last week around $33 a share.

American at the same time reported a first quarter net loss of $1,977,000, largely blamed on a pilot strike. After sale of surplus aircraft, which produced a gain after taxes of $1,129,000, the loss was reduced to $848,000. Revenues totaled $69,474,704 compared with $71,057,403 for the first quarter last year.

Cockpit Authority Outlined by Eastern

Washington—Cockpit command authority of Eastern Air Lines' pilots has been clearly spelled out in a company memorandum to all flight crew members on the operation of the Lockheed Electra (AW April 6, p. 44).

The Mar. 9 memorandum points out that, while flight engineers are responsible for the final power settings for takeoff, maximum estimated takeoff, climb and cruise, the correct settings are made by the engineer following a direct command from the captain.

Normal operating procedures for the Electra, as detailed by the memorandum, are:

- **Takeoff.** The captain or pilot flying the airplane will advance the throttles to approximately 900 deg. turbine inlet temperature, at which point he will call for takeoff power. The engineer will then advance the throttles to takeoff, carefully monitoring turbine inlet temperature and horsepower in order not to exceed 971 deg. or 4,000 hp.
- **Maximum estimated takeoff** power. As soon as the gear has been retracted, maximum estimated takeoff power will be called for by the pilot flying and set by the engineer.
- **Climb.** When the flaps are up and climb speed is established, climb power will be called for by the pilot and set by the engineer.
- **Cruise.** Cruise power will be set by the captain when cruising altitude and configuration have been reached.

As soon as the engineer has set the power called for, he should move back to his normal position.

Northwest Files New Bid to Block BOAC

By L. L. Doty

Washington—Charges and countercharges between the British government and Northwest Airlines were climaxed last week when Northwest made its final bid to block the award of a Tokyo stop to British Overseas Airways Corp.

The bitter controversy stems from a BOAC application to operate a route around the world via Tokyo, San Francisco and New York (AW April 13, p. 38). According to some observers here, the strained British-U. S. relationship caused by the deep-seated argument could result in a British renunciation of the Bermuda Agreement—the bilateral air transport pact between the two countries—if BOAC fails to get the route.

Already, BOAC Chairman Gerard d'Erlanger has threatened that "any frustration of BOAC service is going to arouse or bring into action all government agencies."

Northwest has been standing alone in its opposition to the BOAC bid. On the other hand, BOAC carries the strong support of the British government, the U. S. State Department and, as of last week, the Civil Aeronautics Board's bureau counsel.

Earlier, the CAB denied two separate attempts by the Air Transport Assn. to intervene in support of the Northwest stand on the issues at stake. Pan American World Airways has remained aloof in the case.

In a final brief filed with the Board, Northwest last week made its reply to the "unwarranted and bitter charges" made by the United Kingdom Ministry of Civil Aviation that "undue delay" by the Board had prevented the inauguration of BOAC transpacific service. The carrier said:

"Northwest is not opposing and never has opposed, the prompt issuance to BOAC of a permit covering the routes described in the Bermuda Agreement . . . Northwest is opposing the inclusion of Tokyo—and that is all Northwest is opposing—because Tokyo is not named in the Bermuda Agreement as a point on the United Kingdom transpacific routes."

The brief said that Northwest had actually proposed that the Tokyo issue be severed from the case to permit BOAC to begin its around-the-world service on the target date of April 1. It added that, since BOAC objected to this suggestion, the alleged delay was the result of BOAC's decision and not the fault of the Board.

Northwest has been repeatedly frustrated in its attempts to bring the Tokyo issue up for review or reconsideration by the Board. Prior to filing its final brief, Northwest was denied its request for reconsideration of an earlier Board ruling that Tokyo can be added to the route authorized for BOAC. The CAB also denied the Northwest petition to sever Tokyo from the case.

Meanwhile, BOAC took a public position that an extension of Northwest's route from Tokyo to Hong Kong—which Northwest has been seeking for several years—was "quite unreasonable." Earlier this year, however, the British Ministry of Civil Aviation, in a telegram to Northwest Airlines, indicated its willingness to authorize negotiations between BOAC and Northwest on a Tokyo-Hong Kong route if Northwest would withdraw its formal objections to a Tokyo stop for BOAC.

This Northwest refused to do on grounds that previous negotiations on the route between the two carriers had been fruitless. At the present time, Pan American and Japan Air Lines serve the Tokyo-Hong Kong route.

In its brief with the Board, Northwest said the Bermuda Agreement of 1946 granted the British a route from Singapore to Hong Kong, Manila, Honolulu and San Francisco but not Tokyo. It added that if BOAC is permitted to serve Tokyo, it will be given access to the Tokyo-transpacific market, "an enormous traffic-plum" to which it has no right under the present agreement.

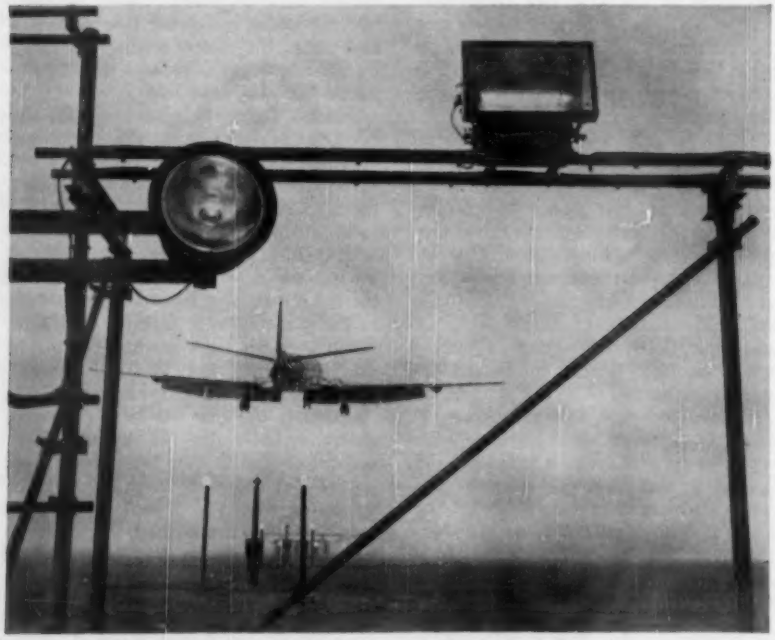
The carrier said that BOAC already serves London-Tokyo traffic on a route through the Middle East which is 3,100 mi. shorter than the transpacific route is between the same two points. It added that the transpacific route properly belongs to the U. S. airlines.

BOAC has noted that, since Northwest serves the great circle route over the north Pacific, it would not compete directly with BOAC which wants the midpacific route. In its brief, BOAC charged that the only issue left in the case is the question of public interest. It added that the Northwest exhibits in the case were "irrelevant and inaccurate" and imply but fail to prove that BOAC's application is not in the public interest.

BOAC called Pan American's failure to intervene or enter in the case as "significant" since the carrier operates the same route BOAC seeks.

Northwest has continued to hold to the principle that Tokyo cannot be added to the BOAC route under the terms of IV(b) of the bilateral agreement since interpretations of that section by both governments indicate it applies only to minor points. Tokyo, Northwest claims, is not a minor point since it is one of world's largest cities.

According to Northwest, the British government upheld this view in a letter sent to the State Department on Jan. 22, 1957, by the civil air attache of



Comet 4 Lands at London Airport

De Havilland Comet 4 jet transport lands in poor visibility at London Airport, aided by high intensity lights, after completing a 23,000 stat. mi. trip in 55 flying hours.

the British Embassy here. The letter served notice of BOAC's intention of inaugurating the transpacific service and, at the same time, reaffirmed its interpretation of section IV(b) to mean that an intermediate point is a "minor" traffic point.

In its brief, Northwest contended that "the letter says, in effect, that the United Kingdom would deny the U.S. what it demands here from the U.S." It added that, if the British are permitted to add "unilaterally" the Tokyo transpacific market to its routes under this procedure, it "can literally remake its routes all over the world: and other countries having the same type of section in their bilaterals with the U.S. can use the Tokyo-transpacific precedent to remake their routes unilaterally at will."

The case is now in the hands of CAB Hearing Examiner Ferdinand Moran who is expected to issue his initial decision sometime late this week or early next week.

Britain Considers Construction Of Two Supersonic Transports

London—British government is considering an industry recommendation that Britain should build not one but two supersonic airliners.

Study by the Supersonic Transport Aircraft Committee, set up more than two years ago by the Ministry of Supply, suggests detailed design work should be undertaken by the aircraft industry on two first-generation supersonic transports.

One would be a 150-passenger Mach 2.5 aircraft capable of nonstop operation between New York and London. The other would be a Mach 1.2 airliner capable of carrying 100 passengers over stage lengths of up to and including 1,500 stat. mi.

Cost of developing the smaller aircraft is estimated at $280 million and that of the larger airliner at considerably more.

This immediately raises the question of whether Britain could afford research and development funds for two such programs.

Committee Representatives

Represented on the committee were members from the major British airframe and engine manufacturers, the state-owned airlines, and the Royal Aircraft Establishment at Farnborough.

The committee's report is based on government-sponsored research and more than 50,000 hr. of wind tunnel model testing.

By recommending both a Mach 1.2 aircraft and a Mach 2.5 aircraft, the committee has left to the government the difficult task of deciding which of the two to back, if both cannot be afforded.

There is no doubt here that government subsidy will be required if the industry is to enter the supersonic transport field.

It is equally certain that such a venture would involve a consortium of firms in the industry.

A stainless steel research aircraft under construction by Bristol Aeroplane Co. is intended for operation in the Mach 2.5 range but, to date, the industry here has no practical aircraft experience at such speeds. English Electric's P. 1 fighter has fully explored the lower supersonic range.

The 150-passenger airliner would be considered a follow-on to the Vickers VC-10 subsonic jet airliner currently on order for British Overseas Airways Corp.

The smaller, slower 100-passenger craft would be a successor to the DH-121 which British European Airways has ordered from de Havilland.

Press Reaction

Press reaction to the long-awaited committee report has been mixed with considerable doubt that the government could afford to sponsor both projects.

"To produce two types, as suggested by the Supersonic Transport Aircraft Committee, is obviously more than the British public can be asked to do unless the industry is going to take a large part of the risk," the Manchester Guardian said editorially. "The issue must be whether to produce one, and if so whether to go for the relatively modest jump over present speeds suggested in the medium-range project or the sharper rise suggested for the longer range."

Britain's decision undoubtedly will be tempered to some extent by the belief that the United States may have a Mach 3 airliner ready by 1969.

Deficit Press Reaction

London—British Overseas Airways Corp. estimates its deficit for the fiscal year ending Mar. 31 at $13.3 million.

This compares with a $7.8 million deficit the previous year.

BOAC Chairman Gerard d'Erlanger says the company broke "approximately" even on its own operations but associated companies had a bad year.

Over-all load factor on BOAC declined by nearly 4% during the year to 56.9%.

Next step by the government, once a decision is made, will be an invitation to aircraft firms to submit design studies. Handley Page, Ltd. and A. V. Roe and Co., Ltd., already have expressed considerable public interest in the supersonic airliner field.

Low Fare Proposal Defended by National

Washington—Contentions that National Airlines' proposed 25% reduction in night coach fares to Miami (AW April 13, p. 39) may lead to such intense competition that the plan will become economically impractical are regarded by the carrier as a refusal of objectors to "recognize the fact that air travel is greatly stimulated by fare reductions."

Answering the objections filed with Civil Aeronautics Board by Eastern, Northwest, Northeast and Delta airlines, National told the Board last week that the proposed fare cut is needed to raise the airline's customary traffic slump from Monday through Thursday, particularly during the summer season. Its proposal, National said, also is an answer to a CAB order last October in which the Board allowed carriers to drop many discount plans but with the stipulation that CAB expected the carriers to develop new fares to attract added traffic.

The airline also said:

"If National, or any other carrier, were to be stopped in its tracks each time it proposed a new fare designed to develop this market . . . simply to protect competing carriers from the competitive effect of reduced fares and without any respectable showing that the fares will adversely affect those carriers . . . the benefits of competition would largely be destroyed by the Board's own actions."

Eastern charges, in particular, that National would need breakeven load factors of 96% on Douglas DC-6 and DC-7 service and 128% for Convair 340 night coach flights, were termed inapplicable to the National plan.

National replied that the Eastern analysis erred in including depreciation and hull insurance costs since these items would accrue in any event. It said the off-peak coach service being planned is designed to achieve a more effective utilization of aircraft, facilities and personnel in the same manner as Eastern's night coach operations. Neither the Convair 340 nor the DC-6 will be used in the new service, National said, adding that the correct breakeven load factors needed, including all flying operations, direct maintenance and passenger service expenses, would be 27.2% for the Lockheed L-1049 H Constellation and 42.8% for the DC-7.

Airline Income & Expenses—Year 1958

(IN DOLLARS)

	Passenger Revenue	U. S. Mail	Property	Federal Subsidy	Charter	Total Operating Revenues	Total Operating Expenses	Net Income Before Taxes
DOMESTIC TRUNK								
American	274,671,977	6,882,499	26,911,273	.....	743,042	310,502,956	284,057,799	31,597,797
Braniff	56,321,407	1,633,872	3,345,520	.....	367,899	61,964,287	55,067,662	6,647,610
Capital	87,654,611	2,122,643	3,070,874	.....	70,933	95,320,182	92,461,993	213,262
Continental	26,161,186	550,801	1,087,399	.....	189,240	28,455,307	27,417,195	−218,165
Delta	81,327,770	2,026,336	5,722,696	.....	545,210	90,137,376	82,943,530	6,963,669
Eastern	210,649,797	3,655,570	8,884,427	.....	123,920	225,157,681	215,188,502	8,706,481
National	53,750,815	1,182,637	3,378,226	.....	657,130	59,529,604	56,489,554	2,505,302
Northeast	22,803,445	393,892	945,991	2,386,257	85,988	26,738,596	30,485,726	−4,288,713
Northwest	59,982,697	2,035,185	4,894,502	.....	279,352	67,581,605	63,827,860	3,534,719
Trans World	191,675,609	4,648,165	10,418,449	.....	469,477	209,608,249	205,179,314	2,572,957
United	267,892,459	10,268,353	22,363,353	.....	2,681,305	305,535,438	273,834,339	29,773,513
Western	30,100,645	716,832	1,284,323	.....	207,661	32,518,706	31,170,408	2,572,982
INTERNATIONAL								
American	5,667,614	40,720	805,541	.....	.....	6,737,083	6,838,927	−102,476
Braniff	6,637,428	105,357	800,520	.....	.....	7,672,932	8,193,139	−581,310
Caribbean-Atlantic	2,033,758	27,178	80,257	.....	27,746	2,233,732	2,014,074	217,572
Delta	5,147,713	60,883	348,452	.....	8,449	5,601,806	5,531,644	48,267
Eastern	19,616,123	383,106	701,662	.....	352,971	21,084,470	19,627,523	1,301,612
Mackey	1,215,097	.....	25,897	.....	55,355	1,303,096	1,483,365	−168,709
National	4,055,548	42,452	289,620	.....	70,006	4,462,065	4,116,608	330,565
Northwest	21,133,203	7,229,704	3,773,009	.....	854,766	34,139,304	27,011,856	6,661,812
Pan American								
Alaska†	.....	.....	.....	.....	.....	.....	.....	.....
Atlantic†	.....	.....	.....	.....	.....	.....	.....	.....
Latin America†	.....	.....	.....	.....	.....	.....	.....	.....
Pacific†	.....	.....	.....	.....	.....	.....	.....	.....
Panagra	13,310,888	552,405	2,514,197	.....	306,567	18,468,507	18,731,967	−201,950
Resort	.....	.....	.....	.....	6,200,695	6,342,385	5,611,931	1,086,351
Trans-Caribbean	2,642,227	.....	72,412	.....	911,900	3,833,979	3,936,918	187,046
Trans World	56,443,743	5,821,694	4,191,633	.....	5,419,420	75,056,062	81,238,503	7,072,904
UMCA	63,610	.....	13,015	.....	.....	76,745	135,358	−58,567
United	13,336,578	548,445	298,954	.....	96,000	14,425,842	12,428,566	1,863,566
Western	1,358,558	6,717	20,396	.....	48,767	1,451,498	1,744,005	−345,642
LOCAL SERVICE								
Allegheny	5,819,200	137,871	304,815	3,453,547	10,487	9,762,539	9,356,771	330,578
Bonanza	2,707,905	42,161	110,702	1,842,717	27,082	4,746,503	4,674,034	70,777
Central	1,824,867	67,593	98,238	2,819,194	31,714	4,870,811	4,693,989	138,028
Frontier*	.....	.....	.....	.....	.....	.....	.....	.....
Lake Central	2,063,194	53,780	83,963	1,784,581	13,066	4,010,039	3,868,569	104,746
Mohawk	6,419,383	78,667	228,213	2,725,817	170,237	9,656,601	8,930,928	431,199
North Central	8,672,224	252,058	238,070	3,311,556	384,957	12,892,731	12,988,225	−139,256
Ozark	5,027,710	112,150	257,902	2,717,615	110,924	8,264,681	7,987,959	222,132
Pacific*	.....	.....	.....	.....	.....	.....	.....	.....
Piedmont	6,139,404	113,603	203,092	2,468,918	96,760	9,252,858	8,919,152	326,775
Southern	2,799,424	100,368	127,425	2,373,221	36,852	5,423,622	5,101,954	313,978
Trans-Texas	3,547,454	120,871	219,568	2,950,024	123,890	7,004,604	6,633,867	349,057
West Coast	2,926,899	48,143	93,375	1,860,565	26,591	4,972,629	5,457,962	−332,515
HAWAIIAN								
Aloha	2,093,996	7,822	92,510	109,150	54,378	2,414,463	2,439,130	−43,911
Hawaiian	4,969,871	46,697	744,017	.....	1,123,212	6,979,469	6,817,768	10,994
CARGO LINES								
AAXICO	.....	43,849	691,515	.....	6,002,580	7,472,562	6,922,484	550,078
Aerovias Sud Americana	.....	.....	1,541,207	.....	293,027	1,868,820	1,921,322	−79,763
Flying Tiger	.....	125,089	11,729,953	.....	22,761,953	35,070,906	31,776,227	2,845,029
Riddle	.....	97,119	5,092,286	.....	4,552,070	9,596,514	11,971,201	−2,944,534
Seaboard & Western†	.....	.....	.....	.....	.....	.....	.....	.....
Slick	.....	16,657	321,600	.....	5,848,820	6,523,967	7,020,300	−279,107
HELICOPTER LINES								
Chicago Helicopter	619,907	45,461	4,361	1,214,460	6,911	1,892,347	1,951,684	−109,991
Los Angeles Airways	182,559	123,329	82,546	940,646	6,165	1,339,066	1,216,062	121,897
New York Airways†	.....	.....	.....	.....	.....	.....	.....	.....
ALASKA LINES								
Alaska Airlines	2,064,943	596,312	556,827	1,882,899	1,078,282	6,250,237	6,338,166	−122,683
Alaska Coastal	731,374	116,517	118,061	349,828	60,629	1,430,614	1,499,454	−107,048
Cordova	120,378	104,483	55,246	415,749	155,892	937,405	985,296	−47,890‡
Ellis	518,239	59,273	72,008	426,859	46,490	1,147,476	1,030,817	111,893
Northern Consolidated	768,983	383,340	420,794	657,621	137,173	2,391,797	2,362,160	14,885
Pacific Northern	6,261,805	783,235	1,054,233	2,106,350	50,580	10,367,771	9,562,553	793,778
Reeve Aleutian*	.....	.....	.....	.....	.....	.....	.....	.....
Wien Alaska	863,676	496,494	305,931	1,060,220	1,275,608	4,065,647	4,218,457	−126,267

* Not available. † Cab Order No. E-13677 permits carrier to withhold financial information. ‡ Operating loss.

Airlines Report Salary, Bonus Payments

Washington—Following is a list of airline officer's salaries, bonuses and indirect compensations, expenses and stock holdings for the year ending Dec. 31, 1958, as reported to the Civil Aeronautics Board.

Trunk Airlines

American Airlines Inc.—C. R. Smith, president and director, $85,000 salary and 40,500 shares of common stock; **W. J. Hogan,** executive vice president-finance and director, $70,000 salary, 1,000 direct common shares and 2,500 shares of common stock in name of others; **O. M. Mosier,** executive vice president-operations and director, $70,000 salary and 4,000 shares of common stock; **C. A. Rheinstrom,** executive vice president-sales and director, $52,500 salary and 100 shares of common stock; **C. W. Jacob,** senior vice president and secretary, $65,000 salary, 20 preferred shares and 5,000 shares of common stock.

C. R. Speers, senior vice president-sales, $55,000 salary, 3,200 direct common shares and 1,375 common shares in name of others; **T. L. Boyd,** vice president, $30,000 salary and 1,600 common shares in name of others; **G. J. Brandewiede,** vice president, $32,500 salary and 2,100 direct common shares.

S. C. Dunlap, vice president, $25,000 salary, 4,000 direct common shares and 1,000 common shares in name of others; **L. E. Glasgow,** vice president and controller, $36,667 salary and 600 direct common shares; **P. W. Kayser,** vice president, $40,000 salary and no stock; **W. Littlewood,** vice president, $35,000 salary and 6,000 direct common shares; **W. Player,** vice president, $36,667 salary and no stock; **G. M. Sadler,** vice president, $25,000 salary and no stock; **N. L. Smith,** vice president, $30,000 salary and 10 direct common shares; **E. C. Taylor,** vice president, $33,056 salary and 100 direct common shares; **G. C. Van Nostrand,** vice president, $40,583 salary, 258 direct common shares and 200 common shares in name of others.

M. Whitlock, vice president, $27,500 salary and 700 direct common shares; **P. G. Larie,** treasurer, $24,000 salary and 2,000 direct common shares; **M. G. Beard,** assistant vice president, $24,000 salary and 3,000 direct common shares; **J. V. Dooley,** assistant vice president, $21,222 salary and no stock; **R. A. Goebel,** assistant vice president, $24,028 salary and no stock; **W. B. Hickman,** assistant vice president, $22,500 salary and no stock; **W. G. Hobbs,** assistant vice president, $17,020 salary and 50 direct common shares; **T. F. Holden,** assistant vice president, $18,000 salary and no stock; **J. D. Hungerford,** assistant vice president, $21,528 salary and 550 direct common shares.

W. C. Lawrence, assistant vice president, $25,000 salary and 650 direct common shares; **D. F. O'Donoghue,** assistant vice president, $26,528 salary and no stock; **H. D. Reynolds,** assistant vice president, $9,338 salary and no stock; **M. L. Rinehart,** assistant vice president and assistant treasurer, $28,500 salary and 100 direct common shares; **M. W. Shipley,** assistant vice president, $22,000 salary and 400 direct common shares; **A. E. Smick,** assistant vice president, $22,222 salary and 40 direct common shares; **C. H. Startup,** assistant vice president, $20,000 salary and no stock; **D. D. Taylor,** assistant vice president, $20,420 salary and 60 direct common shares; **W. B. Whitney,** assistant vice president, $24,000 salary and 10 direct common shares.

F. C. Wiser, assistant vice president, $24,792 salary and 250 direct common shares; **V. J. Long,** assistant controller and assistant secretary, $22,000 salary and 200 direct common shares; **C. N. Ourisler,** assistant controller, $28,500 salary and 200 direct common shares; **W. J. Corbett,** assistant treasurer and assistant secretary, $18,500 salary and 100 common shares in name of others; **A. A. Paradis,** assistant secretary, $17,111 salary, 112 direct common shares and 375 common shares in name of others; **A. R. Bone,** regional vice president, $32,500 salary and 2,700 direct common shares; **W. N. Bump,** regional vice president, $32,500 salary and 1,000 direct common shares; **R. L. Fitzpatrick,** regional vice president, $23,333 salary and no stock.

S. G. King, regional vice president, $27,500 salary and 2,000 direct common shares; **H. J. Lyall,** regional vice president, $22,396 salary and 600 direct common shares.

Following directors were not paid salaries: **H. T. Ames,** 3,500 direct common shares and 2,000 common shares in name of others; **J. W. Aston,** 500 direct common shares; **R. E. Benedict,** 2,000 direct common shares; **J. Bruce,** 1,100 direct common shares; **W. Cisler,** 200 direct common shares; **W. W. Candy, Jr.,** 200 direct common shares; **A. G. Carter, Jr.,** 9,400 direct common shares; **C. S. Cheston,** 400 direct common shares; **T. M. Conroy,** 1,000 direct common shares and 500 common shares in name of others; **F. Burr,** 100 direct common shares; **R. S. Euler,** 3,000 direct common shares; **M. Fleishmann,** 100 direct common shares; **E. W. Herzog,** 1,000 direct common shares; **J. A. Jackson,** 500 direct common shares; **R. W. Miller,** 1,000 direct common shares; **E. M. Queeny,** 15,000 direct common shares.

Following firms and persons were paid for services rendered during 1958: **Alvord and Alvord,** legal, $18,197; **Raymond E. Buck,** legal, $9,031; **Covington & Burling,** legal, $340,102; **Debevoise, Plimpton & McLean,** legal, $243,306; **Savage, Gibson, Benefield and Shelton,** legal, $6,236; **Stryker, Tams & Horner,** legal, $9,824; **American Appraisal Co.,** appraisal services, $13,575; **Wyatt C. Hedrick,** architects and engineers, $14,652; **Kahn & Jacobs,** architects and engineers, $25,498; **Loubet & Glynn,** architects and engineers, $6,798; **Naess & Murphey,** architects and engineers, $18,615; **Kenneth H. Neptune,** architect and engineer, $12,310.

James P. O'Donnell, consulting engineer, $25,694; **Quinton Engineers Ltd.,** construction supervision, $12,535; **John Carl Warnecke,** engineering, $22,954; **Dickie-Raymond,** sales planning, $12,193; **Opinion Research,** marketing research, $92,196; **Real Estate Research Corp.,** marketing research, $18,865; **Charles Cramer, M. D.,** medical, $5,460; **Lovelace Foundation,** medical research, $15,793; **McKinsey & Co.,** management consultants, $115,459; **J. P. Morgan & Co.,** investment bankers, $20,185; **Arthur Young & Co.,** public accountants, $24,686; **American Red Cross,** contribution, $10,755; **Community Chests & Councils of America Inc.,** contribution, $14,925; **Flight Safety Foundation,** contribution $15,000; **Greater New York Fund, Inc.,** contribution, $12,000; **United Funds Inc.,** contribution, $25,110; **United Givers Fund,** contribution, $6,730.

Braniff Airways, Inc.—C. E. Beard, president, $72,000 salary, $5,265 bonus and indirect compensation, $4,218 expenses and 21,600 shares of common stock; **J. W. Miller,** executive vice president, $46,000 salary, $1,381 bonus and indirect compensation, $1,482 expenses and 1,206 shares of common stock; **C. G. Adams,** vice president—finance and secretary, $33,000 salary, $1,170 bonus and indirect compensation, $1,097 expenses and 6,759 shares of common stock; **R. C. Shrader,** vice president, $18,000 salary, $1,215 bonus and indirect compensation, no expenses and 1,200 shares of common stock; **R. V. Carleton,** vice president-operations $36,000 salary, $2,565 bonus and indirect compensation, $1,527 expenses and 4,000 shares of common stock.

R. Brack, vice president-traffic and sales, $24,000 salary, $1,665 bonus and indirect compensation, $5,205 expenses and no stock; **M. Harrison,** vice president—industrial relations, $20,000 salary, $1,365 bonus and indirect compensation, $866 expenses and no stock; **W. Henshel,** vice president-public relations, $20,000 salary, $1,365 bonus and indirect compensation, $917 expenses and 100 shares of common stock; **V. A. Kropff,** assistant vice president—executive projects, $13,200 salary, $855 bonus and indirect compensation, $648 expenses and no stock; **O. W. Crane,** treasurer, $14,869 salary, $980 bonus and indirect compensation, $226 expenses and 213 shares of common stock.

R. L. Barrier, assistant treasurer and budget director, $11,850 salary, $754 bonus and indirect compensation, $75 expenses and no stock; **F. J. Beisecker,** assistant treasurer, $11,850 salary, no bonus, $143 expenses and no stock; **L. Eden,** assistant treasurer, $11,850 salary, $754 bonus and indirect compensation, $158 expenses and no stock; **V. Bowlware,** assistant secretary, $5,100 salary, $248 bonus and indirect compensation, no expenses and 40 shares of common stock; **T. Robertson,** assistant vice president—research and statistics, $10,725 salary, $669 bonus and indirect compensation, $666 expenses and no stock; **H. Bolding,** vice president-purchasing and stores, $14,250 salary, $934 bonus and indirect compensation, $174 expenses and 4 shares of common stock; **C. S. South,** vice president, $17,387 salary, $1,169 bonus and indirect compensation, $3,759 expenses and no stock.

The following directors were not paid a salary or expenses: **F. Jones,** $600 bonus and indirect compensation and 2,132 shares of common stock; **G. Butler,** $600 bonus and indirect compensation and 10,720 shares of common stock; **R. J. Whiteford,** $200 bonus and indirect compensation, and 1,120 shares of common stock; **W. A. Blakely,** $800 bonus and indirect compensation and 517,955 shares of common stock; **T. N. Law,** $800 bonus and indirect compensation and 130 shares of common stock; **G. D. Murdoch,** $800 bonus and indirect compensation and 1,400 shares of common stock; **W. W. Flenniken,** $600 bonus and indirect compensation, and 100 shares of common stock; **J. H. Walker,** $800 bonus and indirect compensation and 2,100 shares of common stock; **M. McGreevy,** $800 bonus and indirect compensation and 4,000 shares of common stock.

Following firms were paid for services rendered during 1958: **Whiteford, Hart, Carmody & Wilson,** legal services, $70,500; **Billups, Wood & Mascho,** audit fees, $8,500.

Capital Airlines, Inc.—J. H. Carmichael, chairman of the board of directors (resigned July 22, 1958), $33,666.67 salary and no stock; **David H. Baker,** president and director, $59,516.68 salary and 100 shares of common stock; **B. G. Lochiel,** senior vice president, treasurer and director, $32,734.18 salary and 4,000 shares of common stock; **W. H. Johnson,** senior vice president and director, $13,011.14 salary and no stock; **J. B. Franklin,** vice president, $28,369.69 salary, 850 common shares and $64,000 worth of 4½% debentures; **R. J. Wilson,** vice president, $24,277.81 salary and 198 shares of common stock; **H. Dever,** vice president and secretary, $19,094.85 salary and 1,900 shares of common stock; **R. G. Chalfant,** assistant vice president, $16,071.17 salary, three direct common shares and 100 common shares in name of others; **S. B. Goldthorpe,** assistant vice president and comptroller, $17,359.11 salary and 502 shares of common stock; **R. W. Hardesty,** assistant vice president, $18,549.20 salary and 100 shares of common stock; **S. T. McAlister,** assistant vice president, $15,176.75 salary and no stock.

W. B. Smith, assistant secretary, $9,677.88 salary and no stock; **R. P. Wright,** assistant treasurer, $16,069.50 salary and 300 shares of common stock; **O'F. Estes,** assistant treasurer, $14,879.18 salary and no stock.

The following directors received indirect compensation rather than salaries: **C. H. Murchison,** no indirect compensation and 78,132 shares of common stock; **J. D. S. Coleman,** $200 indirect compensation and no stock; **W. V. Couchman,** $800 indirect compensation and no stock; **D. L. Fawley,** $500 indirect compensation and 2,000 shares of

There's a little bit of Europe in every corner of

MEXICO CITY

...Western has 2 wonderful ways to fly there!

"Better than a trip abroad!" say visitors to Mexico City. Here's real foreign flavor—the gaiety of Paris, the romance of Vienna, the smartness of Copenhagen. Yet you can "do" Mexico City for so much less money. And it's so *close*—just hours away on Western's...

FIESTA FLIGHTS What luxury! A Fiesta cocktail hour with choice of fine liquors and hot hors d'oeuvres, vintage champagne with gourmet luncheon, orchids, desserts from an elegant Fiesta Cart, reserved seats.

AIRCOACH FLIGHTS Really *low* fares! You fly in spacious comfort—reserved seats and complimentary meals. Only $79 one way (tax-free) nonstop from Los Angeles.

Either way, you fly on new 4-engine airliners, super-pressurized and equipped with radar!

WESTERN AIRLINES

common stock; **G. R. Hann**, $400 indirect compensation and 45,832 shares of common stock; **C. T. Johnson, Jr.**, $500 indirect compensation and 265 shares of common stock; **A. F. Kroeger**, $1,200 indirect compensation and 1,000 shares of common stock; **C. B. Monro**, $1,200 indirect compensation and 152 shares of common stock; **J. D. Neelands, Jr.**, $300 indirect compensation and no stock; **H. B. Smith**, $200 indirect compensation and no stock; **J. T. Stockton**, $700 indirect compensation and 4,310 shares of common stock; **J. F. Culman III**, $300 indirect compensation and 700 shares of common stock.

Following firms and persons were paid for services rendered in 1958: **Adair, Ulmer, Murchison, Kent and Ashby**, legal, $171,000; **Cravath, Swain and Wood**, legal, $21,594; **Bernard B. Smith**, legal, $7,261; **J. B. St. John**, actuary fees, $6,216; **Lybrand, Ross Bros. & Montgomery**, audit and tax services $30,227; **Kenyon & Eckhardt**, advertising, $1,718,175; **Ernst & Ernst**, management study, $32,800; **Arthur Anderson & Co.**, management study, $10,398; **Art Designer's**, advertising, $21,884; **Colortone Press**, advertising, $22,522; **Boersmer Travel Service**, agency commission, $15,394; **College Travel Office**, agency commission, $6,479; **Elkin Hotel & Travel Bureau**, agency commission, $7,569; **Executive Travel**, agency commission, $8,954.

Midland Travel Service, agency commission, $15,114; **Vreeland Travel Service**, agency commission, $5,336; **Wagenarr Travel Bureau**, agency commission, $10,160; **Bankers Trust Co.**, trustee, $5,184; **Chase Manhattan Bank**, trustee, $20,246; **J. H. Carmichael**, management consultant, $26,333; **Metropolitan Detective Agency**, guard services, $9,332.

Continental Air Lines Inc.—R. F. Six, president and director, $53,167 salary and 5,250 shares of common stock; **H. L. Lawrence**, executive vice president and director, $19,958 salary and no stock; **J. A. Uhl**, vice president—finance and director, $21,267 salary and 3,957 shares of common stock; **H. W. Bell, Jr.**, vice president-personnel, $8,000 salary and 161 shares of common stock; **C. H. Calhoun**, vice president-engineering and maintenance, $17,882 salary and 210 shares of common stock; **M. L. Davis**, vice president-sales, $9,435 salary and no stock; **L. H. Dennis**, vice president-passenger service, $17,883 salary and 945 shares of common.

S. O. Halberg, vice president—public relations and advertising, $14,017 salary and 1,155 shares of common stock; **O. R. Haueter**, vice president—operations, $24,167 salary and 2,166 shares of common stock; **C. F. Whelan**, vice president—economic planning, $5,667 salary and no stock; **H. H. Cady**, assistant vice president and treasurer, $8,212 salary and no stock; **F. G. Colnar**, assistant vice president and budget director, $7,000 salary and 63 shares of common stock; **E. B. Rance**, assistant vice president—passenger service, $8,300 salary and no stock; **R. G. Schorling**, assistant vice president—purchasing and property, $8,433 salary, 63 shares of common stock.

D. R. Wilson, assistant vice president—operations, $8,267 salary and no stock; **S. B. Redmond**, secretary, $13,533 salary and 1,433 shares of common stock; **P. F. Kriethe, Jr.**, assistant secretary, $10,150 salary and 5 shares of common stock; **C. C. West, Jr.**, executive vice president and director, $25,250 salary and 4,100 shares of common stock; **H. B. Seifert**, vice president—operations administration, $14,833 salary and 275 shares of common stock.

The following directors received indirect compensations instead of salaries: **L. H. Mueller**, chairman, $400 indirect compensation and 31,395 shares of common stock; **L. C. Ames**, $400 indirect compensation and 12,000 shares of common stock; **A. O. Beckman**, $100 indirect compensation and 420 shares of common stock; **S. G. Cooper**, $400 indirect compensation and 2,625 shares of common stock; **F. L. Ehrman**, $100 indirect compensation and 4,135 common shares in name of others; **M. F. Heilman**, $200 indirect compensation and 11,025 common shares in name of others; **J. G. Holland**, $400 indirect compensation and 3,255 shares of common stock.

W. P. Paepcke, $200 indirect compensation and 2,100 shares of common stock; **F. H. Ricketson, Jr.**, $300 indirect compensation and 6,090 shares of common stock; **T. Roberts**, $100 indirect compensation and 65,152 shares of common stock; **R. J. Smith**, $300 indirect compensation, 5,000 shares of common stock and $30,000 worth of debt securities; **R. Stewart**, $300 indirect compensation and 105 shares of common stock.

Delta Air Lines, Inc.—C. E. Woolman, president, general manager and director $53,396 salary and 41,196 shares of common stock; **T. G. Cole**, vice president—administration and finance and director, $28,396 salary and 841 shares of common stock; **C. H. Dolson**, vice president—operations and director, $28,396 salary, 1,625 direct common shares and 187 common shares in name of others; **L. H. Parker**, vice president—traffic and sales and director, $28,396 salary and 1,875 shares of common stock; **R. S. Maurer**, vice president—legal and director, $19,896 salary and 93 shares of common stock; **W. T. Beebe**, vice president—personnel, $18,896 salary and 112 shares of common stock; **T. M. Miller**, vice president—traffic, sales and administration, $18,437 salary and 50 shares of common stock; **E. Cocke, Jr.**, vice president—civic affairs, $18,437 salary, 1,400 direct common shares and 50 common shares in name of others.

R. Oppenlander, comptroller, $13,500 salary and no stock; **R. H. Wharton**, assistant vice president—personnel, $12,396 salary and 250 shares of common stock; **C. H. McHenry**, secretary, treasurer and director, $1,200 salary and 1,875 shares of common stock; **C. Fitzgerald**, assistant treasurer, $6,389 salary and 4,225 shares of common stock; **H. H. Saxon**, assistant treasurer, $10,599 salary and no stock; **J. R. Howell**, assistant treasurer, $10,198 salary and no stock.

C. B. Wilder, assistant vice president—technical operations, $15,313 salary and 150 shares of common stock; **P. W. Pate**, assistant vice president—properties, $10,963 salary and no stock; **C. P. Knecht**, assistant vice president—sales, $12,238 salary and 272 shares of common stock.

The following directors received no compensation or salaries: **R. W. Freeman**, chairman of the board of directors, $1,200 salary and 8,950 shares of common stock; **R. W. Courts**, 100 shares of common stock; **E. H. Gerry**, 1,175 shares of common stock; **J. R. Longmire**, 2,500 direct common shares and 1,089 common shares in name of others; **W. Nunally**, 13,000 shares of common stock; **C. Putnam**, 7,500 common shares in name of others; **R. J. Reynolds**, 113,625 shares of common stock; **J. W. Rogers**, 800 shares of common stock.

The following firms and persons were paid for services rendered in 1958: **Arthur Anderson & Co.**, auditing and tax services, $18,640; **Chapman, Walsh and O'Connell**, legal fees and services, $13,940; **S. A. Stewart**, special and professional services, $10,000; **L. Y. Cubas**, legal fees and services, $7,982; **Powell, Goldstein, Frazer & Murphy**, legal fees and services, $7,510; **Turner, Rodgers, Winn, Scurlock and Terry**, legal fees and services, $6,069; **Pogue and Neal**, legal fees and services, $5,700; **Antell Wright & Associates**, special and professional services, $5,857; **Raphael Sommes**, legal fees and services, $5,791.

Artist's Conception of Eastern's Idlewild Terminal

New Eastern Air Lines passenger terminal at New York International Airport, now under construction, will be ready for occupancy in June. Terminal building costs $18 million and support facilities another $20 million. Two arcades in foreground will be able to handle 16 aircraft simultaneously. Building features automobile driveways on two levels.

TWA BOEING 707

Now! The new ***TWA BOEING 707*** brings you the miracle of pure-jet flight. It is the fastest, most comfortable jet airliner in the world.

You'll fly half a mile in the time it takes to read this sentence. It is that fast. You'll talk in whispers. It is that quiet. You'll relax completely, no vibration. It is that smooth. And you'll come back to fly this luxurious ship-in-the-sky again and again. It is that great. For reservations, see your TWA travel agent or call TWA.

FIRST AND ONLY JET NON-STOP BETWEEN NEW YORK AND SAN FRANCISCO

FLY THE FINEST... FLY TWA BOEING 707

USA · EUROPE · AFRICA · ASIA

Western Sticks to Regional Concept

By Russell Hawkes

Los Angeles—Turbine-powered transports are not likely to alter the regional character of Western Air Lines. Its management is convinced its investment in western U. S. routes will show a better return than investments in other routes.

Because of this conviction, Western has bought the Lockheed Electra turboprop transport which is considered by the airline as ideal for short and medium length stages that make up its route structure. Western has entered a bid in the Southern Transcontinental Service Case but is only proposing to extend routes as far east as Houston. In the north, the airline would like to extend routes southeast from Minneapolis to Chicago and is requesting the Civil Aeronautics Board to reconsider an earlier rejection of that proposal.

Western also has filed an application in the Trans-Pacific Service Case to run flights to Honolulu from Los Angeles and San Francisco. Officials argue that inclusion of the new western-most state in their route structure is logical because of the regional nature of the airline. If Western wins the route the airline will need pure jets; but it is expected that the CAB decision will not call for service to start before 1962, which would allow enough time to buy equipment.

Western argues that Hawaii shares a stronger community of interest with West Coast cities than with those farther east and hopes to prove this to CAB with traffic figures.

Electra Orders

Western has placed firm orders for nine Electras and has options on three more. The first will be delivered in May and tentative plans are for service to begin Aug. 1. Five are expected to be in service by the end of the year.

Most of Western Air Lines' routes are oriented in a generally north-south direction. This will be even more true when service begins along the requested Salt Lake-Boise-Spokane-Calgary route. Canadian approval of the leg into Calgary, Alberta, is being awaited.

The company is in the process of simplifying its 9,153 mi. route system and making it more economical to operate by eliminating service to some cities where low traffic volume and short stage lengths have been unprofitable.

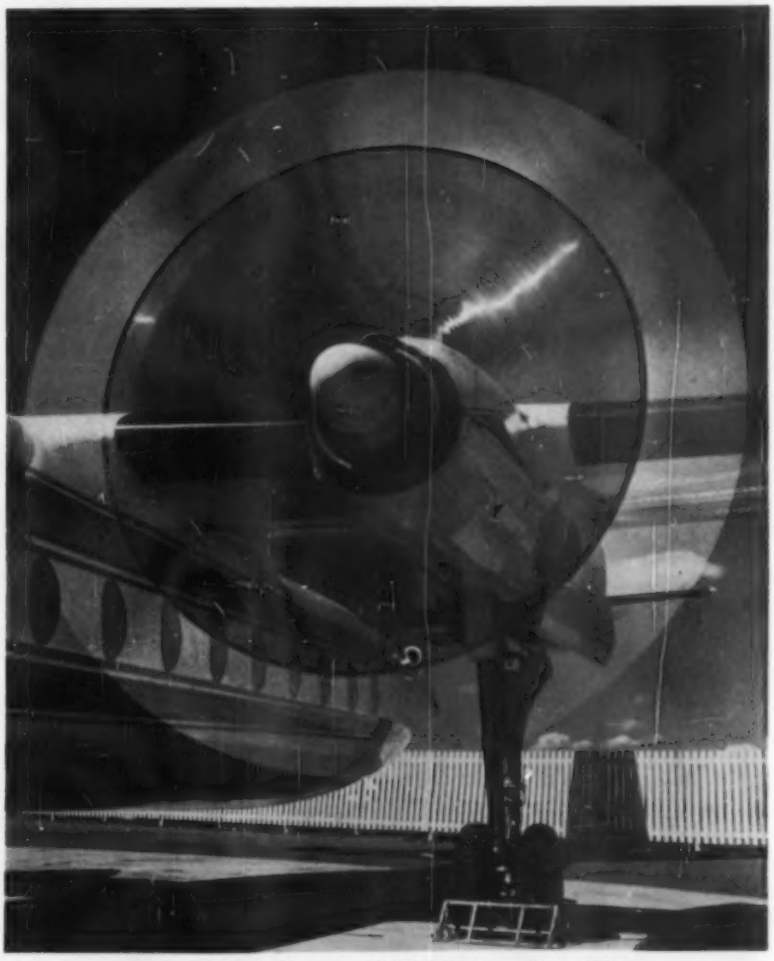
Operating rights at 16 communities will be turned over to subsidized local service carriers in line with a CAB policy of separating trunkline operations from subsidized local service operations.

In the Seven States Area Investigation, CAB authorized Western to suspend service to Rochester and Mankato, Minn.; Brookings, Spearfish and Hot Springs, S. D.; and Chadron, Alliance and Scottsbluff, Neb. Western officials report that CAB has indicated that it would grant final approval early this year to elimination of Lewistown and Cut Bank, Mont.; Logan and Ogden, Utah, and Jackson, Idaho. Service rights to Cedar City, Richfield and St. George, Utah, have already been terminated.

Eliminating some of the stations in the system has enabled Western to sell the last of its Douglas DC-3 equipment; airline now operates only the Douglas DC-6B and Convair 240. This accounts for a considerable saving in maintenance costs, because the Convairliner and DC-6B are powered by Pratt & Whitney R2800-CB-16 engines and there is no need to duplicate facilities, equipment and manpower.

In the Pacific Southwest Service Case, Western is applying for authority to operate direct service between Los Angeles, Sacramento and Reno and between San Francisco and Reno. Western also asked to start San Diego-Long Beach-San Francisco and Palm Springs-Ontario-San Francisco service, eliminating a restriction which now requires stops at Los Angeles.

Western will serve 34 cities after the last of the unprofitable stations has been eliminated. If the airline wins all



Fairchild Coats F-27 Propeller Tips

Tips of this four-bladed Rotol propeller used on Fairchild F-27 Friendship twin turboprop transport are coated with high visibility paint. Aircraft has been certificated by Federal Aviation Agency to use Rolls-Royce Rda.7/Mk. 528 engines, which produce 1,960 eshp. each. Mk. 511 engines, which also are available for F-27s, develop 1,720 eshp.

RECORD RATE OF INCREASE

OF PROTEUS OVERHAUL LIFE

PROTEUS 705 SERIES ACHIEVES

2,000 HOURS

IN UNDER TWO YEARS' SERVICE

Bristol Siddeley Proteus first entered airline service two years ago. Overhaul life on the 705 series has now reached 2,000 hours—a rate of increase never before achieved by any other engine, piston or gas turbine

No engine of comparable power in service today has an overhaul life that even approaches this length. Annual engine overhaul costs for BOAC's Britannia 102 aircraft have now been cut by 75% since the aircraft went into service.

Continued development, even lower fuel consumption. Further increases will give Proteus even longer overhaul life, entailing even lower operating costs. In addition, new versions of this engine—which already has a lower specific fuel consumption than any other gas turbine in civil or military use—are now giving even more power at an even lower specific fuel consumption.

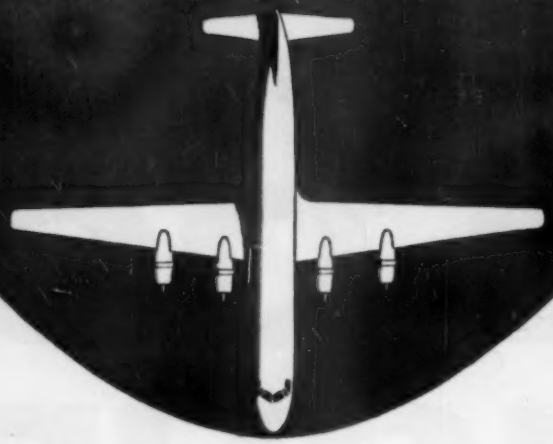
Over 2½ million miles a month in world service Every day, all over the world, Proteus-powered Britannias fly more than 80,000 miles (2½ million miles a month), carrying passengers in quiet, speedy luxury, carrying a great variety of freight loads, and bringing profit to operators.

Bristol Siddeley

ENGINES LIMITED

Sinclair

supplies 45% of the aircraft oil used by major scheduled airlines in the U.S.



Sinclair

aircraft oil is also used to lubricate the mighty engines of commercial and military jets

You can depend on

Sinclair

Aircraft Oils

Sinclair Refining Company, Aviation Sales, 600 Fifth Avenue, New York 20, N. Y.

National to Begin Electra Service April 26

National Airlines will begin scheduled New York-Miami service April 26 with this Lockheed Electra, the first of 23 to be delivered to the airline. Eleven additional turboprop Electras will be delivered to National before the end of the year.

its cases before the CAB, another 12 cities would be added to the system. The pact between U.S. and Mexico under which Western flies its 1,555-mi. Los Angeles-Mexico City run will expire June 30, but company officials expect it to be renewed in inter-governmental negotiations scheduled before that date.

When the Electra has been fully integrated with Western's fleet in early 1960, the line's passenger-carrying capacity will be double what it was in 1955. Company engineers report the Electra is ideal for the 550 mi./passenger average trip over Western routes.

Aircoach Conversion

In the past year Western has bought nine additional Douglas DC-6Bs and sold three. Six of the new ones had 87-passenger aircoach interior configurations. This year, seven aircoaches will be converted to 95-passenger interior arrangements. At the beginning of the year the line's fleet included 27 DC-6Bs and six Convair 240s.

In normal circumstances, Western can claim the lowest break-even load factor in the U.S., according to Stanley Gewirtz, vice president in charge of administration. Break-even load factor for 1958 was higher than normal due to the 108-day pilots' strike, because fixed costs remained close to normal levels while income ceased and because a big traffic regeneration campaign was needed after the long hiatus. In January, 1959, the break-even load factor was only 49.2%. System-wide actual load factor for 1958 declined to 54.3% from 59.8% in 1957. Gewirtz attributes the low break-even load factor to an intelligent route pattern and efficient operation. Company's two types of aircraft are not mixed on any one run which simplifies the task of supporting and maintaining them. Only base in the system which flies the Convair 240 is Salt Lake City and it flies nothing else.

Western officials believe their traffic is well balanced between business travel and the tourist market. Tourist business is a rich plum but unstable in the eyes of the experts. The company has built a good winter vacation business to Mexico City, Southern California, Las Vegas and elsewhere in the Southwest. It is about to begin a campaign to promote summer vacation travel to national parks in the Northwest. Business travel based upon the aircraft, missile and electronics companies of the West Coast and Midwest is supposed to provide continuity of demand. North-south orientation of routes provides a good cross-feed of traffic between Western and big transcontinental carriers.

Rumors arise periodically that Western will merge with one of the regional trunklines in the East to create a new transcontinental network. However, Gewirtz says he can think of no airline with less reason to merge than Western.

He told AVIATION WEEK that the company is not interested in getting into the competition east of Chicago and on the transcontinental runs but would rather spend the effort in staving off competition in its own region.

Company officials believe that west of the Mississippi, geography is working for the airline. For one thing, distances are greater. No two metropolitan areas are within 100 mi. of each other, Western reports. This, in combination with the mountainous terrain of the far West, discourages surface travel and in some cases makes air transportation essential.

Experience level in the company is quite high but average age of department directors and vice presidents is only about 43. Despite the long pilots' strike of 1958 in which more than 2,000 employes were furloughed, a large percentage of them elected to return to the company. At the beginning of 1959, 46.3% of Western's employes had more than five years of seniority with the company and only 20.3% had been with the company less than a year.

Western is in the midst of negotiation with Allison Division of General Motors to get the Allison-built powerplants for the line's new Electras under a lease rather than as part of the airframe purchase. Initial cost of Western's Electra fleet would be cut by about $4 million if the lease can be arranged. American Airlines already has such an agreement with Allison and only the mass of paperwork stands in the way of Western.

BEA Alters Markings For Comet, Vanguard

London—British European Airways will use new markings on Comet 4B and Vanguard airliners going into service next year.

Entire wing surfaces, top and bottom, will be bright red. Vertical and horizontal stabilizers will be white with a large red BEA on the fin. The white roof on the fuselage will be retained but with a broad black stripe the depth of the windows running from nose to tail.

AIRLINE OBSERVER

► All airline common stocks listed on New York Stock Exchange are now registering sharp gains. On one recent occasion, when prices generally were uneven in slow trading, seven of the 11 carriers listed reached new highs for the year.

► **Recent upturn in passenger traffic and gross revenues (AW April 13, p. 45) is creating industry speculation as to the degree such prosperity will influence the final decision in the Civil Aeronautics Board's passenger fare investigation. Although decision will be based on long-range requirements of the industry, many observers fear present gains may not be conducive to the full fare increase majority of trunklines still feel is necessary to back re-equipment programs.**

► Eastern Air Lines has cut its order for 20 Douglas DC-8s to 16. According to the carrier's annual report, the contracts were renegotiated "as a result of a re-evaluation of needs for the straight-jet Douglas DC-8 type aircraft. . . ."

► **Federal Aviation Agency is evaluating a study of the economic feasibility of an all-weather landing system. Cost of installing and operating ground and airborne equipment is being balanced against cost savings to airlines and general aviation and contribution to accident prevention.**

► American Airlines should show substantial though non-recurring increases in earnings this year and next because of the increasing delivery pace of its piston-engine aircraft to buyers. All 24 Convairs purchased by Frederick B. Ayer will be delivered this year and so will the 25 Douglas DC-7s purchased by General Aircraft and Leasing Corp. This could add $10-12 million to American's 1959 pretax earnings. Bulk of the 45 DC-6s purchased by Ayer will be delivered next year. Although American's statements should look impressive as a result, the proceeds from these sales are already committed for use in jet purchases.

► **Air Traffic Controllers Assn. has issued complaints to Federal Aviation Agency that controllers assigned to Air Defense Command radar sites are being required to work 12-16 hr. daily without overtime pay. Controllers admit they are not actively occupied with duties during the prolonged periods but are, nevertheless, obliged to stay on the job. FAA is investigating complaints, believes problem stems from misinterpretation of split-shift requirements.**

► Soviets report that piston-engine Russian transport planes ranging from Il-14s to An-2 biplanes have become so plentiful that the USSR and its satellites are experiencing an "explosion" of new air service to small cities and remote population points. Mongolia, with its largely nomadic economy, says it has now inaugurated regular flights from Ulan-Bator, the capital city, to all 17 of the country's administrative regions following acquisition of more Soviet-built planes. First scheduled operations to three districts began two years ago. The Mongolian civil airline has also placed newly-received Russian Il-14s on its two international routes: Ulan Bator to Irkutsk and Ulan Bator to Peking.

► **Sud Caravelle turbojet transport has been certificated by the Federal Aviation Agency and will be placed in scheduled service next month on Air France and Scandinavian Airlines System.**

► Federal Aviation Agency Administrator Elwood R. Quesada has resigned as special assistant to the President in order to devote full time to his duties as administrator. In accepting the resignation, President Eisenhower agreed there was no longer a need for the post of special assistant. The President also has directed the Bureau of the Budget to act upon Quesada's recommendation that the "usefulness of the Air Coordinating Committee" should be examined.

► **Universal air travel plan cardholders increased more than 60,000 in 1958, double the 1957 gain, to reach a total of 881,077 cardholders representing 84,782 subscribers' contracts.**

SHORTLINES

► **Air Express Division** of the Railway Express Agency reports that 34 U. S. domestic and international airlines carried 1,446,731 shipments of air express during the first quarter of 1959, a 13.8% increase over the first three months of 1958. Gross revenues for the period were $11,018,603, 20.5% above the first quarter of last year.

► **American Airlines** flew 431 million revenue passenger miles during March for an increase of 8.8% over March, 1958. During the month, American also flew 8.4 million revenue ton miles of air freight, an increase of 13.4% over March of last year.

► **Chicago Helicopter Airways** carried 27,035 passengers during the first quarter of 1959 for a 23% increase over the 1958 first quarter figure. The company reports net earnings of $85,176 for 1958 from operating revenues of $2,169,357.

► **Flying Tiger Line** carried $3,457,696 worth of air freight during the first quarter of the year, a 39.6% gain over the same period of last year. March volume rose 31.8% over 1959 to $1,239,460.

► **Icelandic Airlines** plans to begin a Friday flight to Amsterdam from New York beginning May 8. A return flight, originating in Luxembourg, will depart on Sundays. Round-trip fares of $453.60 will be reduced to $407.60 with the beginning of the low season Aug. 16.

► **KLM Royal Dutch Airlines** carried 941,000 passengers during 1958, a 3% increase over 1957, and flew an aggregate of 182.2 million ton miles of traffic. Operating revenues for 1958 were down to $129 million from $130.6 million for 1957. Net earnings declined to $3,292,000, or $2.30 per common share on 1,429,190 shares outstanding. KLM attributes the declines to cancellation of landing rights at Jakarta, Indonesia, a pilots' strike in March and general declines in the economy of a number of countries served by the company.

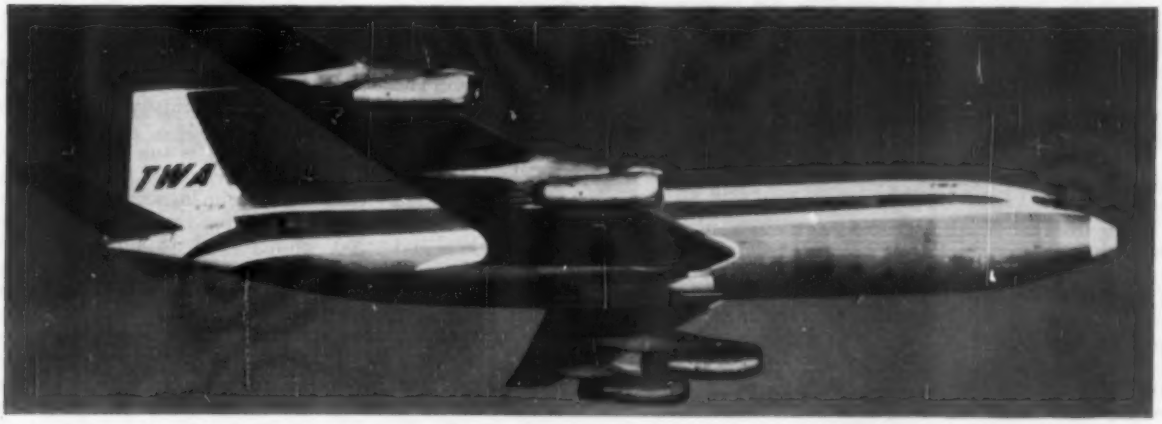
► **Northwest Airlines** flew 143,378 passengers 110,346,800 revenue passenger miles on domestic routes during March, a 59.1% increase over March last year. International revenue passenger miles rose 42.0% to approximately 27,212,000 during the period. Total system-wide figures rose 50.6% over March last year to 137,558,800 revenue passenger miles.

REPORT ON OPERATIONS

IN SERVICE, the Boeing 707 has set record after record, both for performance and passenger appeal. A Los Angeles to New York passenger flight was made in 4 hours, 3 minutes. During the first 60 days of this service, the 707 averaged a load factor of more than 95%, an unprecedented high in passenger appeal.

RESERVATIONS in the thousands for flights months ahead have poured in. A noted aviation writer reports: "The tremendous public acceptance of the 707s and their great revenue-producing ability have been among the most significant commercial-aviation developments since the Second World War."

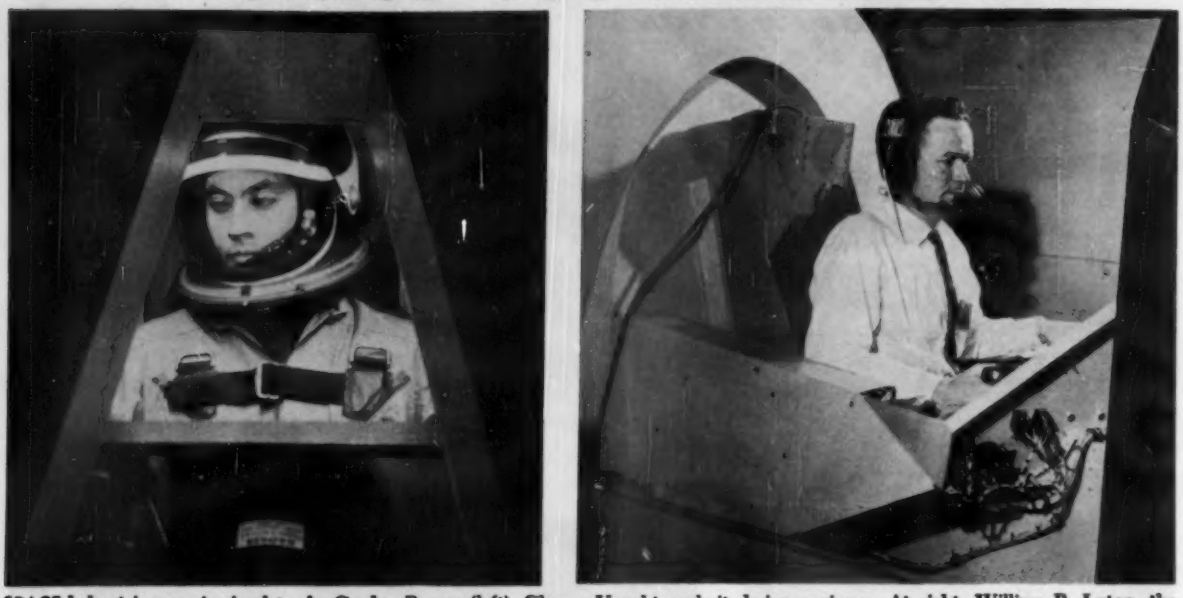
THE 707 has broken all trans-Atlantic airliner records, flying New York to Paris in 6 hours, 4 minutes, and New York to London in 5 hours, 41 minutes. 707 passenger loads to Europe have been at record levels averaging a winter load factor of 94%. In addition, 707s carried up to 5 tons of mail and cargo each flight. Boeing jets are profit-making jets. Seventeen airlines have ordered a total of 190 Boeing jetliners—a reflection of confidence in Boeing, the world's most experienced builder of multi-engine jet aircraft.



707s NOW LINK San Francisco to New York in 4 hours, 50 minutes. Here again, 707s have set new records for speed and passenger appeal. Over both transcontinental and overseas routes, 707s have demonstrated tremendous earning power, extremely high initial utilization and unprecedented public acceptance.

BOEING
Family of jet airliners

These airlines already have ordered Boeing jetliners: AIR FRANCE • AIR INDIA • AMERICAN • B.O.A.C. • BRANIFF • CONTINENTAL • CUBANA • IRISH LUFTHANSA • PAN AMERICAN • QANTAS • SABENA • SOUTH AFRICAN • TWA • UNITED • VARIG • *Also* MATS



SPACE helmet is worn in simulator by Gordon Bryson (left), Chance Vought cockpit design engineer. At right, William B. Luton, the company's simulator coordinator, checks out in the space flight trainer. Sliding cockpit canopy is closed during a simulated hypersonic flight; only pilot vision is through forward windshield and small side windows.

Space Trainer Simulates Hypersonic Orbit

By Craig Lewis

Dallas—Critical areas of boost glide vehicle flight patterns have been studied here in an orbital navigation simulator developed by Chance Vought Aircraft, Inc., to explore the unknowns of manned hypersonic glider operation.

In a two-month research program, this simulator has flown more than 200 flights in which pilots have gone through the orbital, re-entry and hypersonic glide phases of the boost-glide vehicle flight pattern. Studies have been aimed at finding out whether a pilot can exercise enough control to accomplish his mission and at determining what cockpit display information he needs to do the job.

Developed with company funds, the simulator can be adapted to demonstrate flight characteristics of vehicles ranging from the North American X-15 research vehicle or the Project Mercury capsule to a powered space glider, but Chance Vought built the system basically to study boosted, unpowered hypersonic gliders because this type of vehicle is mort sophisticated than either the X-15 or Mercury capsule, yet demands more precise handling than the powered glider.

Greatest unknowns in the boost-glide flight cycle are the orbital, re-entry and hypersonic glide aspects, and the Chance Vought simulator is limited to these three areas. A centrifuge arrangement would be necessary to simulate the boost phase, making it impractical in this program, but much research has already been done in this field. Once past the hypersonic glide area, the glider becomes a high speed aircraft, and the problems of supersonic, transonic and subsonic flight are quite familiar by now, so the initial boost and final supersonic flight phases were excluded.

Complete Simulation

Chance Vought simulator generates a complete simulation of the flight control and navigational aspects of flight from booster separation to arrival over the target, but it does not provide dynamic motions and therefore can't simulate the physical effect of such a flight on the pilot. Studies indicate that man is perfectly capable of handling the flying job simulated here and that training him for the job can be done relatively easily.

In building and operating this real time simulator, Chance Vought believes it is simulating for the first time the general theories on re-entry techniques which were outlined over 20 years ago. The program dealt with relatively early vehicles in the space era, but Chance Vought's simulator coordinator W. B. Luton points out that any practical space vehicle has to be flown back to a landing spot, and this probably means flyable gliding vehicles will be used. In its program, the company was trying to learn how to manipulate a glider on a global scale and bring it in at the proper spot and how to survive re-entry.

Except for direct physical effects on the pilot, such as g-forces, the simulated vehicle behaves just as a hypersonic glider of its class would. This hypothetical vehicle has all the equations of motion, areodynamic parameters, temperature equations and equations for navigating on a global scale. Long period and short period dynamic characteristics are present. Full control capability, both primary and trim, is provided.

The simulator is run by a bank of analog computers, and the system includes 270 amplifiers, 26 servomecanisms and 10 function generators. Four X-Y plotters and 18 brush recorders track the progress of each flight. Complete analog operation exists only between 100,000 ft. and 300,000 ft. during the flight, and the orbital trajectory is governed by a function generator above 300,000 ft. This injects an artificial atmosphere into the flight above 300,000 ft., but the simulation is all-analog in the critical altitudes where re-entry and hypersonic glide take place.

The simulator itself is a typical single seat cockpit which is somewhat more

spacious than current fighter cockpits. Pilot is completely enclosed during flights, and he communicates with test engineers through an intercom system. He faces a panel containing the operating instruments he needs to fly the vehicle, plus an array of dummy instruments Chance Vought has used in experimenting with panel layouts.

Operating instruments are arranged generally in a T-shaped layout with the flight control instrument at the top of the vertical bank indicator. This attitude instrument is a single beam cathode ray tube with a glider symbol and a moving artificial horizon in its center. At the top is a horizontal bank angle indicator calibrated up to 60 deg. right and left. Down the left side is the pitch or angle of attack indicator, calibrated from 10 to 70 deg. Along the bottom is an uncalibrated horizontal slot with a ball that moves laterally to serve as a side slip indicator.

Under the flight control instrument is a dual beam cathode ray tube which serves as a navigation instrument. Glider is always at the center, and a long line running from the center indicates direction to target. A shorter line indicates flight direction, and a third line ending in a blip shows yaw angle. The line showing direction to target recedes from the display perimeter during the last 1,000 mi. of flight, and it can be switched between scales of 1,000 and 300 mi.

Energy Management

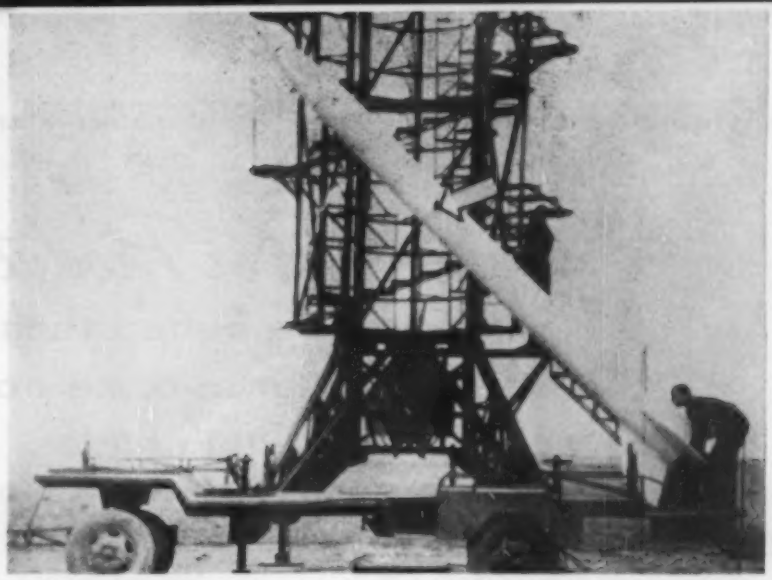
Beneath the navigation display is an energy management instrument, and below this is a dial which tells the pilot the remaining distance to target.

To the left of the flight control instrument is a velocity meter which reads in feet per second, indicating hundreds with needle-and-dial and thousands with a disk read through a window. On the right side of the flight control display is the altimeter. Farther to the right is the temperature gage with a yellow zone arbitrarily beginning at 1,600F and a red zone starting at 2,000F.

Also on the right side of the panel are a clock and a fuel supply gage for the reaction control system. On the left side are a g-meter and a bank of push buttons for firing vernier rockets.

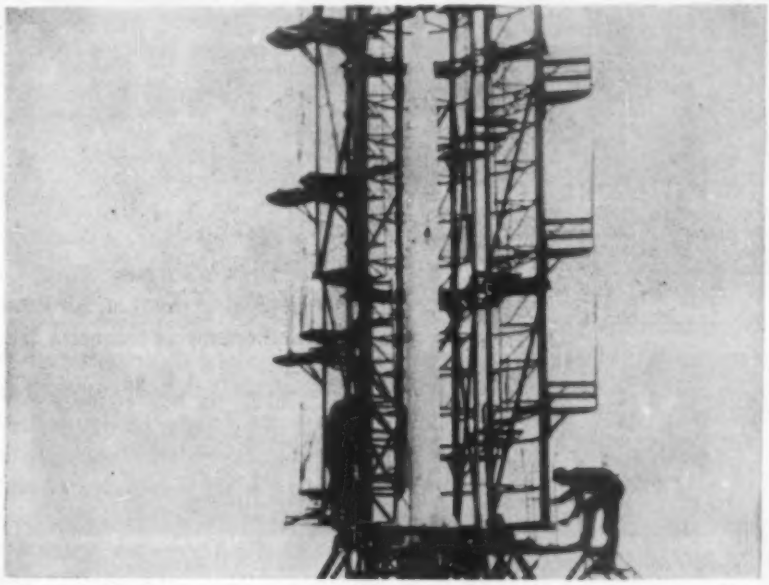
Controlling is done with a side stick on the right arm rest. Roll motion is controlled by tilting the stick to the left or right, pitch by moving it up or down and yaw by moving it to left or right. Pitch and roll trim are also on the side stick, but yaw trim is at the fingertips on the left arm rest.

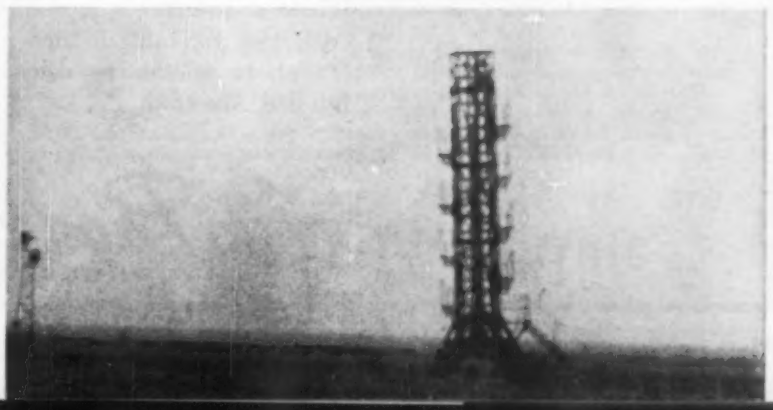
Full orbital and re-entry run in the simulator with Luton as the pilot demonstrated that the flight control instrument is the key to success in hypersonic glider operation. All instru-



Soviets Erect Meteorological Research Rocket

Soviet meteorological research rocket that resembles U. S. Aerobee rocket is about 18 ft. long, approximately the same length as early Aerobees. Uncomplicated transporter (top) does not erect rocket. Erection is accomplished by cable attached to rocket near center of gravity (arrow). Launching tower is adjusted by hand-turned jacks. Tower has one section that swings open like bird cage door to receive rocket, then closes for launching. Spiral staircase (middle) has landings to serve as work platforms. Tower is tilted from vertical (bottom) and has stabilizing guy wires. Tower at left appears to be for holding cameras, telemetry equipment, or floodlights for night launchings.

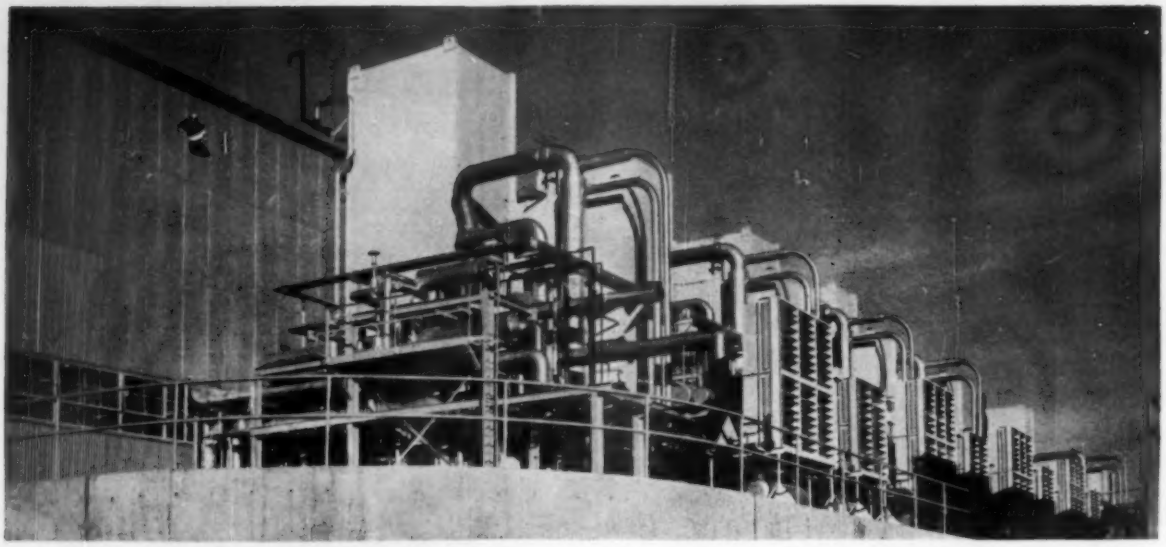




any quantity • any purity • any temperature • any gas or liquefied gas

Air Products

complete facilities offer in-base control of vital utilities



LOX producing facilities designed, built and operated by Air Products, Incorporated, for the U. S. Air Force at Santa Susana, California.

WHETHER it's a new concept, or the reliable supply of an established product, Air Products' scientific, engineering and operating resources are at your disposal.

When the Ballistic Missile Program needed large quantities of liquid oxygen for engine development and missile testing, a program of multiple-unit 75 ton-per-day plants was designed, manufactured and brought on stream with amazing rapidity. After startup, a typical facility paid for itself in oxygen savings alone in less than a year's time.

Whatever your needs in the fields of gases or applied cryogenics, you can gain time, money and independence of outside utilities by contacting Air Products . . . Box 538, Allentown, Pa.

Air Products
...INCORPORATED

ments must be monitored and are used in flight, but it is attitude control that is most critical in keeping heat within viable limits and in managing the energy situation so the glider arrives over target at the proper velocity and altitude. Re-entry runs made by an AVIATION WEEK reporter pointed up the key role of the attitude display.

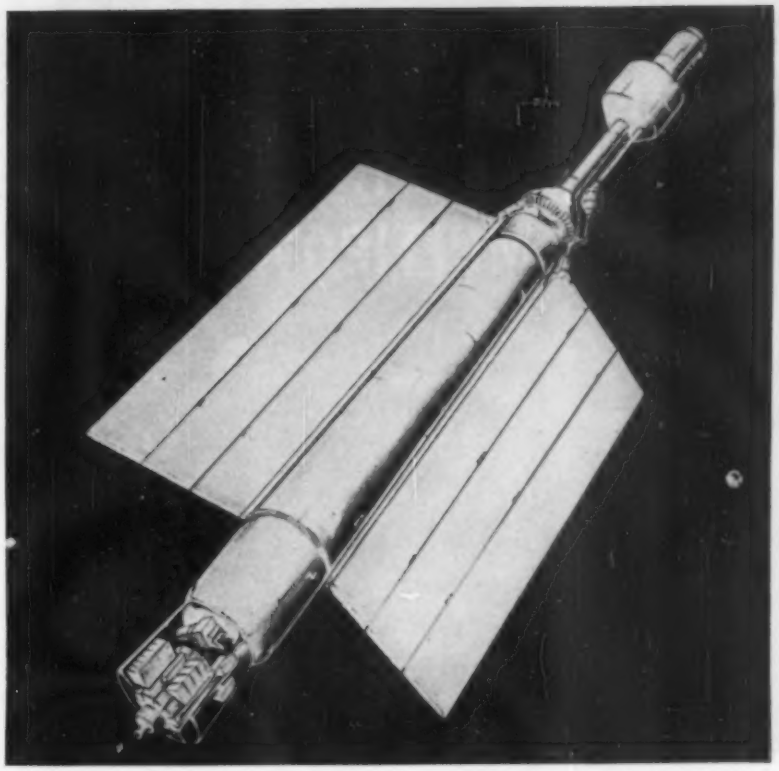
Luton, who has flown 75 hr. in the simulator, made a typical glider simulator run in which he was boosted off from Galveston, Tex., into an orbital flight which terminated at Dallas, making a nearly complete trip around the earth on a great circle route. Glider was launched from Galveston into an orbit inclined 40 deg. from the equator, and the vehicle separated from its boosters over Atlanta when it had reached 350,000 ft. and a velocity of 25,740 fps. The separation was time zero for the flight record.

Flat Trajectory

From separation, the glider climbs along a rather flat orbital trajectory and is at 354,000 ft. three minutes later over Cape Hatteras, N. C., with a velocity of 25,720 fps. At this altitude, Luton has turned off one of his two reaction control systems since it is not needed to maneuver. When the glider drops below 315,000 ft., both reaction control systems are used, and below 250,000 ft. reaction controls are shut off and the vehicle uses aerodynamic controls, which operate at all altitudes.

At nine minutes, the glider is over the Azores at 365,000 ft. and still climbing toward apogee, and at 12 min. it has reached 370,000 ft. and 25,640 fps. over Casablanca. Luton found his velocity dropping ahead of schedule, so at 13 min. he fired vernier rockets along his flight path to increase velocity. Despite some misfires, the boost was sufficient to bring the velocity within comfortable range of the schedule and the glider was flying at 25,790 fps. and 374,000 ft. over Addis Ababa.

If the glider velocity had been too high instead of too low, Luton would have turned it around 180 deg. and fired the booster rockets forward along



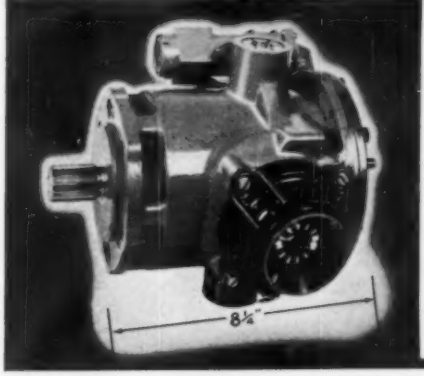
Republic Envisions Unmanned Space Vehicle

Unmanned space vehicle envisioned by Republic Aviation Corp. would be powered by a plasma jet engine in which power would be produced by compressing electrons and ions in a cylinder of magnetism. Vehicle would weigh about 35,000 lb. Republic has been working on development of a plasma jet engine for more than a year.

FLIGHT ACCESSORY POWER

HIGH RELIABILITY...

Constant Speed Drives on Navy A4D



Over 100,000 flight hours have demonstrated the exceptional reliability of the G-E ball-piston design. Not one failure of the pumping elements has ever been reported in service. Mission reliability of .9996 is the result of unmatched design simplicity.

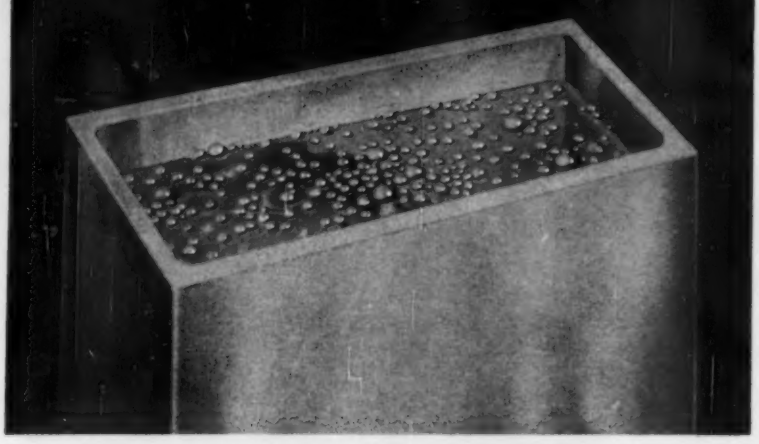
The lightweight, compact units also insure a low overhung moment and are compatible with any aircraft engine. In addition, they can be used with any make of 400-cycle a-c generator.

Drives using the unique ball-piston principle are today delivering precisely controlled speed to the electrical systems aboard the Convair 880 and McDonnell F4H, as well as the Douglas A4D. 231-26

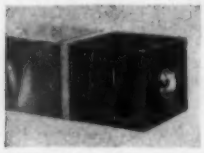
Progress Is Our Most Important Product

GENERAL ELECTRIC

ONLY ACOUSTICA ULTRASONIC CLEANERS HAVE MULTIPOWER!



MAJOR BREAKTHROUGH IN ULTRASONIC TECHNOLOGY!



In determining which ultrasonic cleaner to buy, remember that all ultrasonic cleaners are not alike. There is variation in uniformity of cavitation. There is variation in the transducer — and the transducer is the heart of an ultrasonic cleaner. The Multipower transducer developed by Acoustica research, multiplies the power and efficiency of ultrasonic action. Cleaning is faster, labor costs are lower.

Acoustica ultrasonic cleaners are engineered and produced to the finest standards, unequaled in quality and value. Off-the-shelf in capacities from 1 to 75 gal. or custom built to 5000 gal. Expert Acoustica engineers can help you with your cleaning problems. Send for further information.

acoustica

Leader in research and development of ultrasonic systems

Los Angeles & New York

Acoustica Associates, Inc.
Dept. AW, 26 Windsor Ave., Mineola, N. Y.

Send information describing advantages of Acoustica ultrasonic cleaners.

Name_____

Company_____

Address_____

City_____ Zone_____ State_____

his flight path, using them as retrorockets. Since the atmosphere is negligible at this orbital altitude, the pilot has considerable room for maneuver and can maneuver his vehicle into any desired position for observation, photography or other functions. Normally, though, he will maintain the proper forward flight attitude to take advantage of the very small amount of effect available from the rare atmosphere at orbital altitude to maintain his schedule.

Apogee Reached

Apogee was reached east of Addis Ababa when the glider hit 375,000 ft. at 25,600 fps. Now altitude begins to drop, and the vehicle is down to 360,000 ft. over the Indian Ocean with 32 min. of flight behind and 12,000 naut. mi. remaining to the target.

Off southwest Australia, altitude is

Soviet Spectrograph

Soviet rocket spectrograph is designed to photograph the solar spectrum beyond the limits of the earth's atmosphere. Photo is heavily shaded at right.

525,000 ft. and distance to target is 9,700 mi. Near Melbourne, the glider is down to 295,000 ft., velocity has decayed to 25,430 fps., and the re-entry phase is beginning. During this trip around the world, Luton has been reporting at his various check points, and the test engineers have been giving him sighting reports from ground stations. This interplay is valuable in creating as real a simulation as possible for the pilot, and it also helps him stay alert for the demanding re-entry job. In an actual orbit, the pilot also will have the stimulus of reporting scientific observations.

Crucial Attitude

With the re-entry phase beginning, flight attitude becomes crucial. The vehicle is flying at a positive angle of attack varying generally between the 17 deg. angle which is the maximum lift/drag (L_D) ratio value, and 55 deg., which offers the maximum coefficient of lift (C_L max.) Angle of attack is important in temperature management during re-entry because raising the nose offers increased bottom surface for drag and, therefore, for heating. The pilot wants to keep his nose below a critical angle for heating when temperature is a problem, and a red light on the panel flashes to warn him to "lower nose" when overheating is a prospect.

Temperature indication in the cockpit is governed by bottom surface temperature of the vehicle since the vehicle's bottom is the element which offers the varying drag as angle of attack is changed and is most sensitive to temperature variations associated with this drag. Heat is a function of velocity, altitude and attitude, and the temperature simulation integrates these variables. Equations are written to express the amount of heat for the three combined.

Attitude also is crucial to energy management. The pilot uses his angle of attack to conserve or expend energy as required to arrive over the target in the proper situation L_D max. is the most efficient glide configuration, and the glider pilot will stay close to this 17 deg. angle if he wants to conserve energy and stretch his glide. If he sees that velocity is too high, he will raise the angle of attack toward C_L max. to get maximum lift with a high drag penalty. In this condition, the vehicle dumps

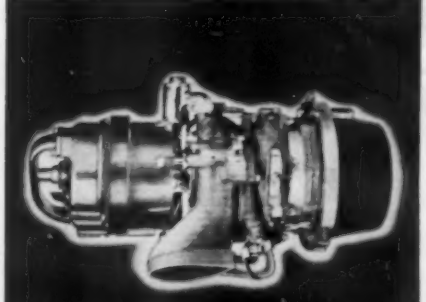
AiResearch Develops Animal Space Capsule

Space capsule, designed to carry a mouse into orbit, is air conditioned and pressurized to create artificial atmosphere. Capsule was built by AiResearch Division of Garrett Corp.; oxygen supply, which will last for 30 days, is stored under pressure and metered into the capsule through a regulator. Oxygen is recirculated by a fan, fed back into the capsule after passing through carbon monoxide remover and water separator. AiResearch engineer John Potter points to copper tubing used for recirculation; smaller tube wrapped around the copper tube cools the circulating air.

FLIGHT ACCESSORY POWER

HIGH RELIABILITY...

Cartridge Turbostarters on USAF B-57



With a million and a half successful starts during a five-year period, G.E.'s solid-propellant turbostarters have demonstrated their dependability and have proven their adaptability to varied operating conditions.

Over 2000 cartridge starters have been produced and are being used every day at tactical bases all over the free world.

Solid-propellant, fuel-air, and cartridge-pneumatic turbostarters are available, with torque ratings from 350 to over 1000 foot-pounds —to meet the requirements of any gas turbine engine now flying or contemplated. 231-27

Progress Is Our Most Important Product

GENERAL ELECTRIC

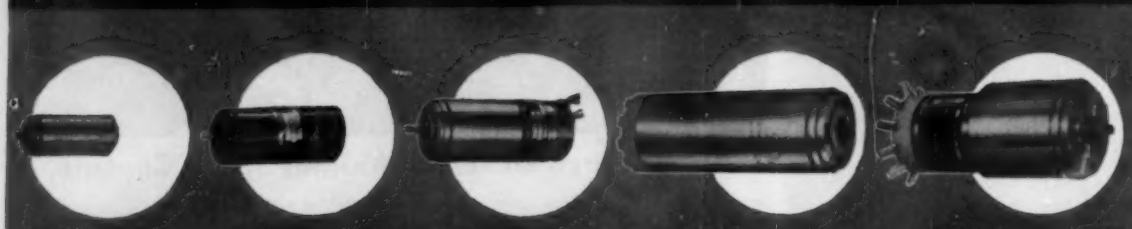
COMPLETE LINE 125° C

SERVO MOTOR TACH GENERATORS

to your precise specification

Oster®

- Both Damping and Integrating types available with parameters to your requirement.
- Complete size range: 8, 10, 11, 15, 18. Can be designed with gear train.
- —54° C to +125° C ambient temperature range.
- Designed to MIL-E-5272.
- Assembled under closely controlled environmental conditions.



400 CPS SERVO MOTOR—TACHOMETER GENERATORS

Oster Type	Size	Length Inches	Wt. Oz.	Rotor Inertia gm cm²	MOTOR					GENERATOR				
					Rated Voltage Ø 1	Ø 2	No load speed RPM	Watts per phase @ Stall	Stall Torque OZ. IN.	Excit. Volt.	Output Volts per 1000 RPM	Lin.% in 3000 RPM	Null MV	Phase Shift @25°C
8MTG-6201-01	8	1.850	2.3	0.77	26	40/20	6,500	2.2	0.16	26	0.25	0.5	15	± 5°
*10MTG-6228-02	10	2.157	4.2	0.72	115	115/57.5	9,500	2.8	0.26	115	0.45	1.5	19	±10°
10MTG-6229-12	10	2.100	2.9	1.09	33/16.5	52/26	9,500	3.0	0.28	26	0.45	1.5	13	±10°
*10MTG-6229-03	10	2.100	2.9	1.09	26	26	10,500	3.0	0.26	18	0.3	1.5	12	±10°
10MTG-6229-15	10	2.100	2.9	1.09	26	26	10,500	3.0	0.26	26	0.3	1.5	12	±10°
*10MTG-6232-05	10	2.104	4.2	1.1	115	36/18	6,500	3.5	0.26	115	0.30	1.5	15	±10°
11MTG-6251-13	11	2.531	7.0	1.3	115	115/57.5	6,500	3.5	0.63	115	0.55	0.5	19	±10°
11MTG-6251-00	11	2.531	7.0	1.1	115	40/20	6,500	3.5	0.63	115	0.55	1.5	19	±10°
11MTG-6254-01	11	2.200	6.0	1.1	115	115/57.5	6,500	3.5	0.63	115	0.55	1.5	19	±10°
15MTG-6280-01	15	3.281	14.0	5.3	115	115/57.5	5,000	6.2	1.5	115	3.0	0.2	13	± 5°
†*15MTG-6276-03	15	3.875	15.0	4.4	115	57.5	8,500	5.8	0.70	115	2.75	0.2	13	± 0.5°
18MTG-6302-02	18	3.680	20.0	5.7	115	115/57.5	9,000	16.0	2.7	115	3.0	0.2	13	± 5°
18MTG-6302-04	18	3.680	20.0	5.7	115	115/57.5	4,800	9.2	2.4	115	3.0	0.2	13	± 5°

*Those units designed for 85°C ambient but same characteristics can be designed for 125°C. †Additional 21.4 watts for heater, the values given are independent of ambient temperature.

Other products include servos, synchros, resolvers, motor-gear-trains, AC drive motors, DC motors, servo mechanism assemblies, reference and tachometer generators, servo torque units, actuators and motor driven blower and fan assemblies.

John Oster MANUFACTURING CO.
Your Rotating Equipment Specialist
Avionic Division
Racine, Wisconsin

EASTERN OFFICE
237 North Main Street
Hempstead, L. I., New York
Phone: IVanhoe 3-4653
TWX Hempstead N. Y. 708

WESTERN OFFICE
5333 So. Sepulveda Blvd.
Culver City, California
Phones: EXmont 1-5742 TExas 0-1194
TWX S. Mon 7671

Engineers For Advanced Projects: Interesting, varied work on designing transistor circuits and servo mechanisms. Contact Mr. Robert Burns, Personnel Manager, in confidence.

velocity without losing altitude. Monitoring the temperature gage guides the pilot in temperature management, and watching his energy management instrument and monitoring the distance-to-target dial tells the pilot whether he needs to stretch his glide or dump energy to arrive on target.

With a constant angle of attack, a glider flying a perfect trajectory will follow a curving, descending flight path in which at any point all the forces acting on the vehicle—centrifugal force, gravity, lift, and drag—are in equilibrium. With so many natural and operational variables involved, this perfect path isn't liable to be maintained and the vehicle will re-enter the atmosphere at a slight angle to this ideal flight path. This angle can't exceed 2-3 deg. or the vehicle will burn up.

Oscillations Cycle

At this slight angle, momentum and gravity will carry the vehicle below this ideal flight path until lift becomes a dominant factor and the vehicle will bounce and start a cycle of oscillations centered on the ideal path which will gradually damp out as altitude and velocity decrease. In practice, this damping doesn't occur in a direct rate because the pilot is changing his angle of attack during the re-entry and hypersonic glide.

Re-entry was made at 275,000 ft. and 25,460 fps., 7,500 mi. out, and Luton made his first bounce at 260,000 ft. and a velocity of 25,000 fps., with 6,800 mi. to go to the target and 49 min. elapsed. Over a distance of 1,200 mi., he rose to 310,000 ft., indicating that these oscillations are very shallow. On the downswing, Luton held a high angle of attack, dumping energy while conserving altitude so that he bounced again at close to 260,000 ft., but velocity was down to 23,800 fps. This second upswing came near Tahiti. Vertical velocity during these oscillations reaches a maximum of about 250 fps.

These oscillations continue as the vehicle approaches the target, coming back deeper into the atmosphere and reducing speed as skipping pattern of re-entry proceeds. As the glider re-crossed the equator 3,000 mi. out from Dallas, Luton began a left turn away from the orbital path and toward the target. This turn occurred at 253,000 ft. and a velocity of 22,500-fps. while the glider was starting to climb on its third upswing.

At 1,000 mi. out, the glider is at 225,000 ft. and flying at 16,000 fps., and both altitude and velocity are now dropping at a very high rate. From this point, Luton could see the end of the navigation display line from glider to target begin to recede from the display perimeter; he has been navigating by keeping his flight path line directly under the glider-to-target indicator, as well as keeping the yaw angle indicator lined up with the flight path line.

When the glider is 600 mi. out, altitude is down to 210,000 ft. and velocity down to 14,000 fps. Within 100 mi. of the target, the glider is dropping at up to 500 fps., and it arrives over target at 160,000 ft. and 7,000 fps., a speed in the Mach 7 range. From this point, the glider spirals down to a landing. If the pilot sees he is approaching the target too fast or too high, he can start a side swing around it from some distance out to get his position down within acceptable parameters over the target.

AVIATION WEEK experience in runs beginning at 300,000 ft. in the re-entry phase showed some of the problems and possibilities of the glider system. In one largely uncoached run under the hood, some pitching oscillations were induced through overcontrolling during re-entry, and these oscillations brought the nose too high for temperature management, driving the temperature gage into the red and burning the vehicle up.

At the end of one run, poor energy management brought the glider in over Dallas too high and too fast, so that a landing on target probably would have been impossible and an alternate landing spot or a ditching would have been necessary.

Conversely, with considerable coaching, the AVIATION WEEK operator brought the glider down from 300,000 ft. in another flight to a position over the target which was generally acceptable. Such an experience with an untutored operator would indicate that the job of training a man to operate a hypersonic glider successfully shouldn't take too long or be too difficult.

Third Titan ICBM Fired; Missile Carried Jato Units

Third USAF-Martin Titan intercontinental missile has been successfully test fired from Cape Canaveral, Fla. Missile carried a complete Bell Telephone Laboratories radio command guidance package that operated but was not connected to flight controls and two Grand Central rocket Jato bottles that will be used on later separation shots to push the second stage ahead. First stage is 54 ft. long, 10 ft. in diam. Second is 37 ft. long, including nose cone, and 8 ft. in diam.

FLIGHT ACCESSORY POWER

HIGH RELIABILITY...

Another Important General Electric Product

Superior dependability and continuing product excellence is based on advanced technology, extensive operating experience, and competent servicing in the areas of

- Hydraulic Equipment
- Controls
- High Speed Equipment
- High Temperature Equipment
- Servomechanisms
- Hot Gas Generators

FOR MORE INFORMATION, contact Product Information, Aircraft Accessory Turbine Department, Lynn, Mass., or mail the coupon.

Section A231-28
General Electric Co.
Schenectady 5, New York

Please send me information on:

☐ Jet Engine Starters ☐ Constant Speed Drives ☐ Unconventional Power
☐ Gas Servo Systems ☐ Auxiliary Power Units ☐ Other:

NAME_____

POSITION_____ COMPANY_____

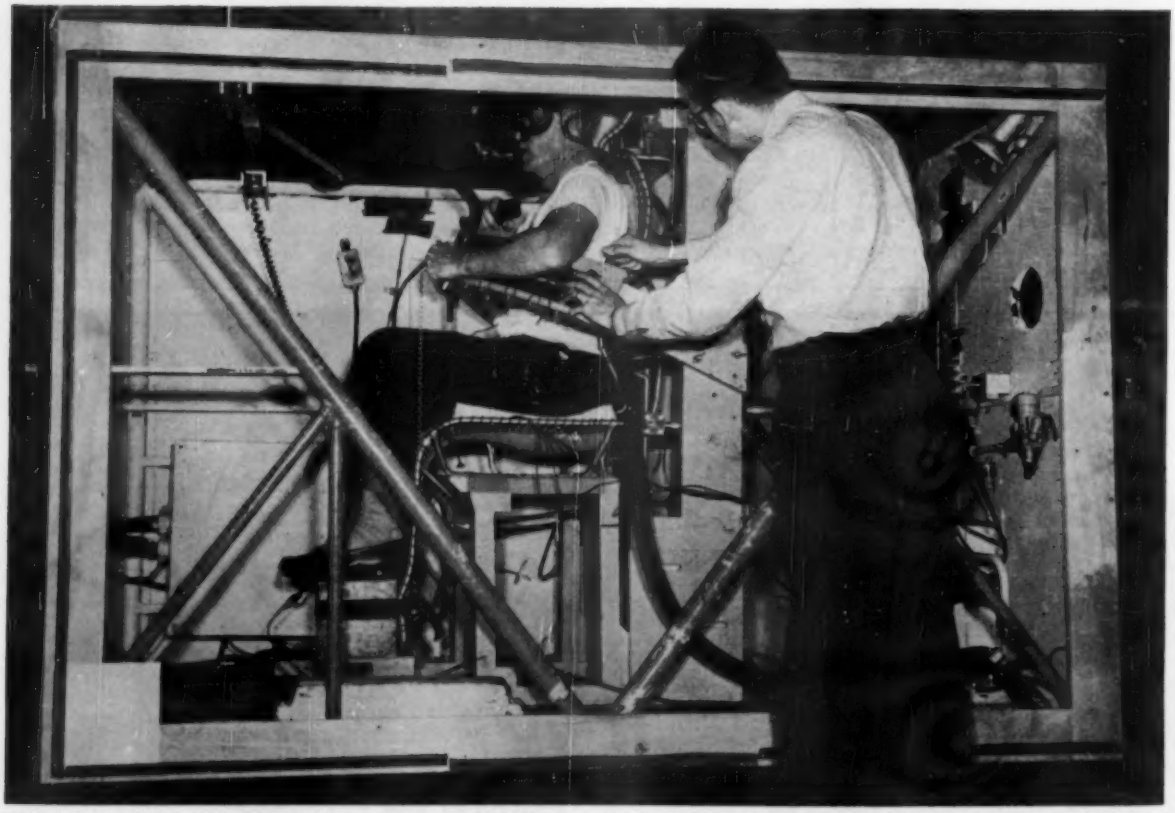
ADDRESS_____

CITY_____ STATE_____

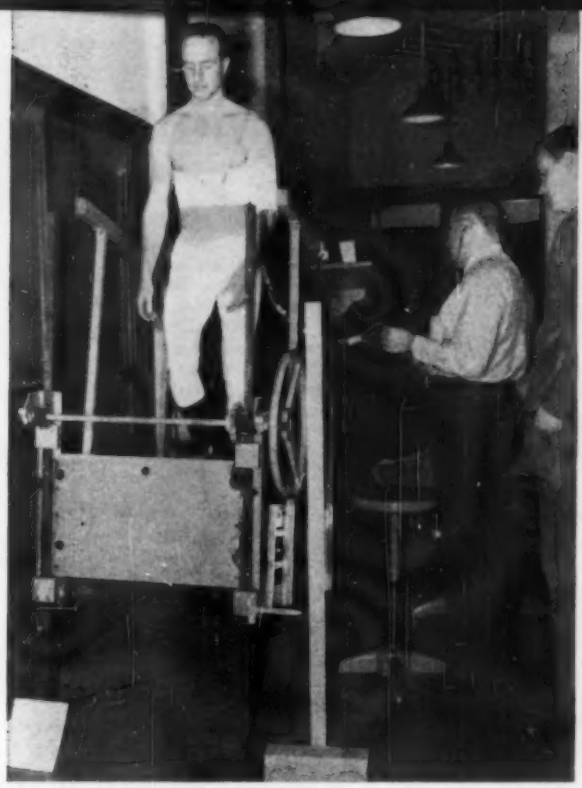
GENERAL ELECTRIC

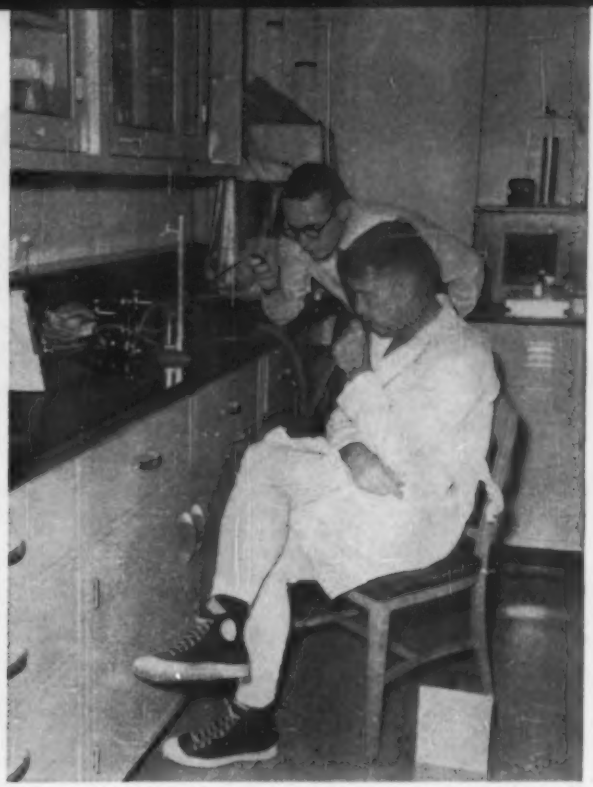
One of seven military test pilots selected as probable crewmen for Project Mercury man-in-space program, Capt. Virgil I. Grisson, USAF, left, operates an equilibrium chair which rotates simultaneously on two axes. He is attended by Dr. Joseph Mundie during the National Aeronautics and Space Administration tests. At right is Capt. Donald K. Slayton, shown in pressure chamber.

Project Mercury Candidates Start Fitness Tests



Lt. Col. John H. Glenn, Jr., USMC is shown in Wright Air Development Center centrifuge, preparing for a test to measure his abilities to cope with multiple gravity forces. Seven candidates were selected from a list of 32 (AW April 13, p. 35).





Navy Lt. Malcolm S. Carpenter is given a stress check on a treadmill (left) at Wright Air Development Center, Dayton, Ohio. Test is a measure of physical fitness. At right is Lt. Cmdr. Walter M. Shirra, whose lung capacity is being tested by blocking the nose and blowing through a tube. Candidates will train at Langley Research Center, Va.

Capt. Donald K. Slayton, USAF, is seated (left) in the WADC isolation chamber as part of a test to measure his ability to cope with unusual conditions. Test is conducted in a completely dark and soundproof room. Heat test, with Lt. Carpenter as the subject (right), was conducted in a chamber heated to 130F. Training at Langley will be carried out by NASA's Space Task Group.

Power Airs SAC Deterrent Capability

(Because the current debate over the military strength of the U.S. versus the Soviet Union is of utmost importance, AVIATION WEEK *is publishing the text of testimony by Gen. Thomas S. Power, commander, Strategic Air Command, before the House Subcommittee on Defense Appropriations (*AW Apr. 13, *p. 21 and 30.)*

Mr. Mahon. General Power, we are pleased to have you present this morning with some of your staff.

This committee, which is charged with the responsibility of recommending appropriations for the defense of the country has been probing into the capacity of the United States to strike back in the event of an attack upon us. We want to know just how good you are. We want your official views and we want your personal opinions. We want you to be completely uninhibited and unhampered in your presentation to us.

If we are sure that we have adequate deterrent power today, and if we are sure that we will have it next year, and the next, and the next, and so on, and if we are sure the opponent knows it, then we will have greater assurance that war will be averted and that we will have a period of relative peace in which we can seek to iron out the differences between the East and the West and thereby save civilization from destruction. Do you have a written prepared statement?

General Power. No, sir.

Mr. Mahon. Have you been briefed by the Pentagon as to what you should tell us and what you should not?

. . . **Mr. Mahon.** All right. Now will you proceed in your own way with your presentation?

General Power. I think it would be helpful to the committee if I briefly describe the mission of the Strategic Air Command and some of the problem areas which today make it more difficult to carry out the mission, and then touch very lightly on some of the philosophies which underlie our actions.

Briefly stated, the mission of the Strategic Air Command is to be prepared to conduct strategic air operations on a global basis so that, in the event of sudden aggression, SAC can mount simultaneous nuclear retaliatory attacks designed to destroy the warmaking capacity of an aggressor to the point that he no longer would have the will nor the capability to wage war.

The important thing is that the Strategic Air Command has that capability today and has had it in the past.

We think this has acted as a potent deterrent to all-out thermonuclear war.

Whether or not anybody agrees with me is really beside the point. The important thing is that this world has not been engaged in an all-out thermonuclear war. This is a real good way to keep it, because if we get into one there will be no winners—only losers in varying degrees. So there is a tremendous challenge today to stay out of war on our terms. I would like to underscore our terms, because obviously, if we give in and quit, we will not be involved in a thermonuclear war.

Ours is a mission of deterrence. That is the national policy. The national policy is that war is not an acceptable method for settling men's arguments.

In this role of deterrence there are new problems facing us today, and I would like to discuss some of these problems with you.

Before I do that I would like to make this observation: We in the Strategic Air Command are well aware of our position and responsibilities as an integral member of the over-all U. S. military team, and we do not consider ourselves the sole deterrent force. However, we do feel very strongly that we can and must contribute the major share to the deterrent posture of the over-all free world.

Problem Areas

In discussing the problem areas I will mention about four general areas. The first one is very obvious. It concerns the dramatic advances in military technology. This has brought about a host of problems. It is at one and the same time a villain and a friend, because it presents the problem and it also presents the solution.

A second problem area concerns the gradual increases in the Soviets' defense capability. This is a two-edged sword. It makes our job in the Strategic Air Command of penetrating or delivering these bombs more a deterrent point of view is that—whether he has this capability or not—it is liable to raise Mr. Khrushchev's confidence factor that, thinking he has or actually having an adequate defense system, he can handle our retaliatory forces—in other words, strike with impunity.

Again, I would like to emphasize that, whether or not he has it, is secondary. If he thinks he has it, that is all that is necessary for us to lose our deterrent posture.

The third problem area is not well understood. I call it the fantastic compression of time—warning time and reaction time—with which we are faced today. I will talk more about that later.

A fourth problem area, the one which is the crux of our business, is the problem of survivability of SAC's strike capability in case of a sneak attack by bombers, missiles, or both.

GEN. THOMAS S. POWER

These are real problems. As they increase in scope and complexity, our capability has to increase commensurately if we are to deal with future contingencies as successfully as we have with those in the past. Stated differently—the mission remains the same, one of deterrence; the threat is increasing and, therefore, our capability has to increase with that threat.

What can we do about it? What are some of the things we are doing?

I will mention four obvious things.

Mr. Flood. In direct ratio to the threat?

General Power. No, these are not in direct ratio.

One, we must tighten our defenses against sabotage. For today, if an aggressor thinks that through saboteurs he can pin down the retaliatory force just prior to launching a surprise attack and thus catch them on the ground and neutralize or destroy them, this approach becomes very attractive.

It is difficult, as you know, to guarantee protection against a trained saboteur. There is a great danger of slowing yourself down by taking such security measures that your own people cannot operate with the freedom that is necessary.

We do feel, however, that we can protect our alert airplanes. We are determined to do that, and also to protect our control centers, two vital elements of our business.

On the credit side of the ledger, historically and traditionally, an aggressor never likes to entrust his plan to saboteurs, because they have a bad habit of getting caught. But I would like to make this statement: The real experts in this business say that the danger of sabotage is greater today than ever before.

So much for sabotage.

Hardening of Bases

A second thing that we can do and are doing is what we call "harden" our bases. This word has several connotations. I will apply it first to missiles. As you know, the ICBM will be operated by the Strategic Air Command, so we are vitally interested in missiles.

We feel we must harden our missiles for the obvious reason that they will have to ride out the attack. I will explain that a little more in detail later, but I want to leave you with this thought: You cannot recall a missile once you launch it, so missiles should be hardened as rapidly as we can get them hardened.

As you know, the first squadrons of Atlas will be in "soft" sites. Then we will harden to 25 pounds to the square inch. It will be feasible to go to 100 pounds to the square inch; the technicians and manufacturers tell us that. I think we should get to that degree of hardening as rapidly as we can, in a logical fashion.

Mr. Flood. What does that mean?

General Power. One hundred pounds to the square inch. The missile site will withstand that overpressure.

It will not withstand a direct hit by a

Original R. T. Handeville painting shows Sparrow III being delivered by McDonnell F4H-1.

SPARROW III AND CECO . . . On the Navy's team of advanced air defense weapons, the radar-homing, air-to-air missile Sparrow III promises to play a starring role.

As prime contractor, Raytheon Manufacturing Company called on Chandler-Evans to produce an important *servo control valve assembly* for use in the missile's radar antenna actuation system.

The ability to manufacture, assemble and test close-tolerance mechanisms — often working directly from the customer's engineering drawings — has earned high regard for CECO as a subcontractor. When demands for quality and accuracy border on the "impossible" . . . ask CECO to review your drawings with the view of producing the necessary equipment on a subcontract basis.

CHANDLER-EVANS CORPORATION WEST HARTFORD 1, CONNECTICUT

Interesting, informative literature on many CECO products is yours for the asking. Please address your request to Dept. 29.

CECO
SYSTEMS
CONTROLS

GENERAL ELECTRIC

T58

The T58, now in production, delivers more power per pound of engine, consumes less fuel per hp-hr than any other turboshaft flying today. Guaranteed at 1050 shp, 0.64 SFC, this 271-pound G-E helicopter powerplant has flight-proven its high performance, ruggedness, and reliability. Now on test is the 1250 shp first-step growth version.

T64

General Electric's T64 is a turboprop/turboshaft engine in the 2600-hp class. It is a compact, versatile power package for rotary-wing or fixed-wing aircraft, or as a power source for radically new airborne applications. Now on test, General Electric's T64 engine is confirming its exceptional performance advantages.

J85

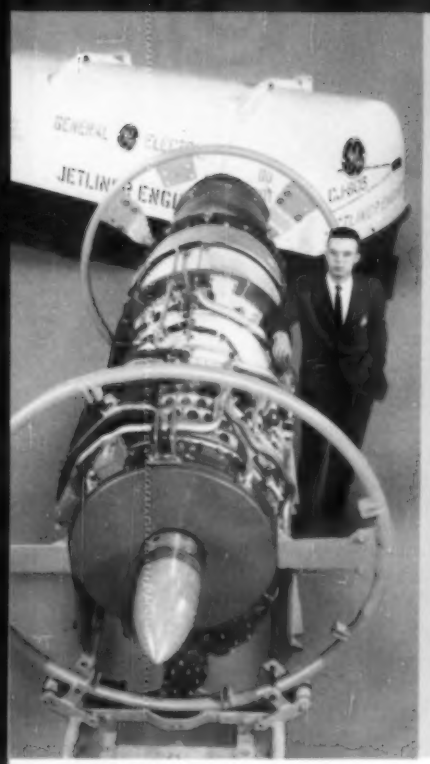
G.E.'s powerful, lightweight J85 turbojet is a 2000-lb-thrust class engine, designed to provide significant dollar savings and performance advantages for missiles, drones, small and medium sized aircraft. The J85 is being flight tested in McDonnell's "Quail" decoy missile and North American's T39 utility trainer.

From hover to Mach 3 ... reliable pe

Progress Is Our Most Important Product

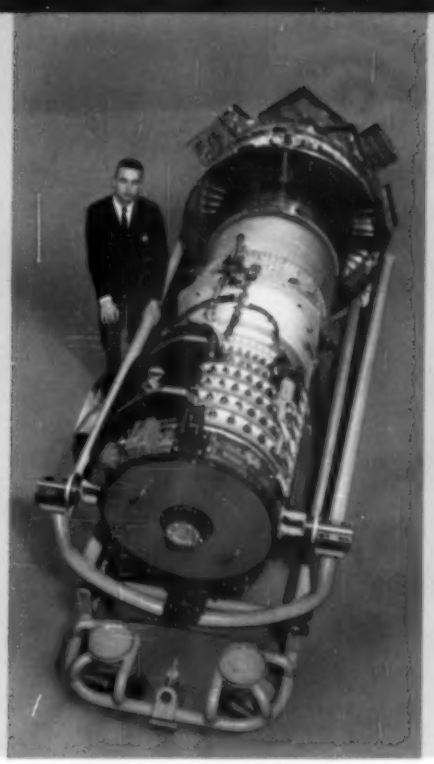
GENERAL ELECTRIC

FLIGHT POWER SPECTRUM



CJ-805-3

G.E.'s commercial counterpart of the military J79. Rated in the 10,000-lb-thrust class, it provides a 4:1 thrust-to-weight ratio. Now being proved in extensive flight test programs, the -3 will power Convair's 880 jetliner. General Electric-built engine reverser-suppressors on the -3 produce optimum results with minimum losses.



X220 and CJ-805-23

The first successful U.S. turbofan engine. Designed for near-sonic military aircraft, the X220 combines the proved J79 gas generator with an aft-fan, provides higher thrust at lower SFC. Its commercial version, the CJ-805-23, will power Convair's 600 luxury jetliner. New turbofan growth models being developed assure long service utilization.

J79

The 15,000-lb-thrust class J79 powers six Mach 2 air weapons, including the USAF F-104 Starfighter, world's record holder for speed, altitude, and time-to-climb. Other applications: USAF's B-58, Navy's F4H, A3J, F11F-1F, and Regulus II. With over 90% of U.S. Mach 2 flight time, the J79 has demonstrated its ruggedness and reliability.

J93

General Electric's J93 Mach 3 turbojet — still highly classified — will power North American Aviation's F-108 long-range interceptor and B-70 intercontinental bomber. Along with other advanced turbojet engines currently under development, the J93 typifies General Electric flight propulsion progress. 239-21

formance ... more power and less weight

TURBOSHAFT
TURBOPROP
TURBOJET
TURBOFAN

LIFT FLAP

Doesn't Miss a Trick!

. . . *The Fenwal Simultaneous Monitoring System*

<u>continuously</u> *senses temperature at 100 or more separate points.*

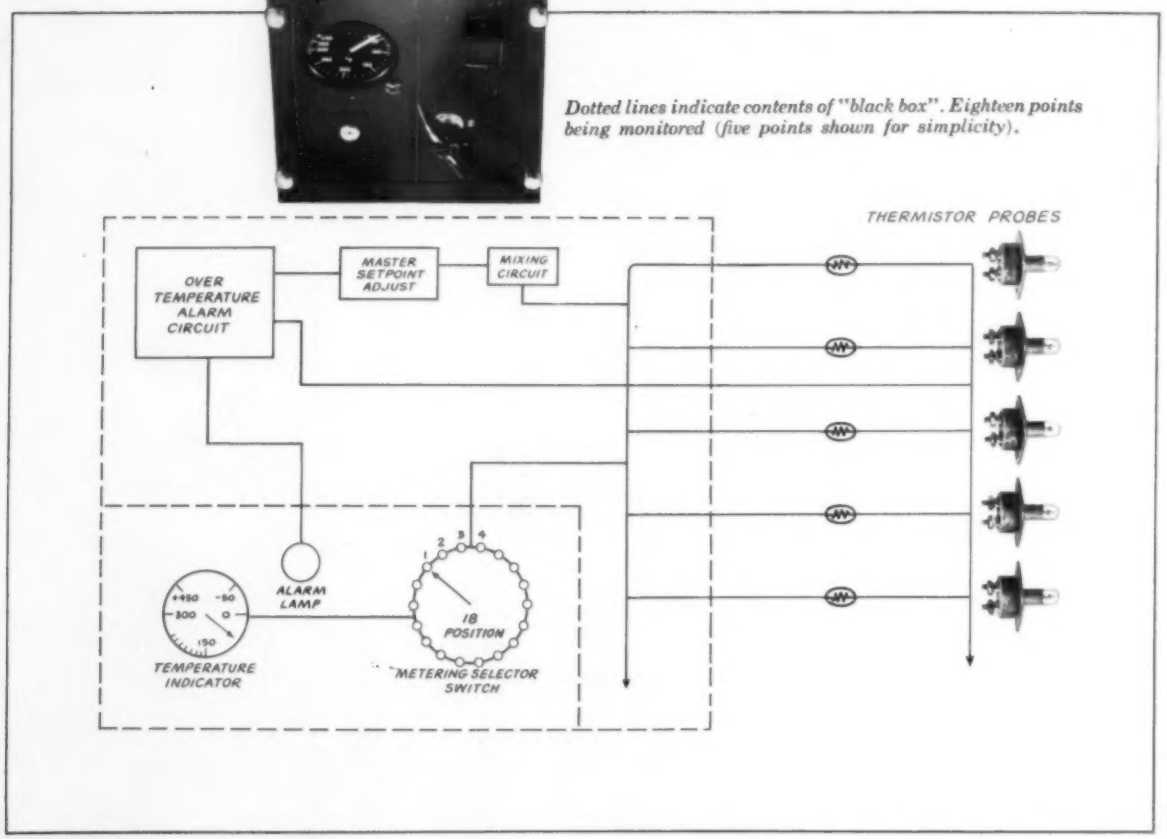
You always know the temperature condition at every point covered by this Fenwal Monitoring System. There's no switching from point to point. With each probe continuously "on duty" *it's literally everywhere at once!*

System's solid-state components are small, light, and wear-free — permit sensitive, reliable response. Fenwal thermistor sensors with practically infinite life change resistance sharply when temperatures go "off limits" . . . feed strong electrical signals to rugged, transistorized amplifier: *Tiny, they can go directly to the trouble spot!*

Fenwal Simultaneous Monitoring Systems are flying with all the new commercial jets and many missiles and military aircraft; in baggage compartments, leading edges, bleed air ducts, etc. They're repeatedly proving their "better engineering" by a company with highly integrated manufacturing facilities, including its own source of thermistors. *Truly "static" systems with dynamic capabilities!*

For complete details or complete engineering of *your* specific monitoring problem, write Fenwal Incorporated, 124 Pleasant Street, Ashland, Massachusetts.

Master warning of the Fenwal Simultaneous Monitoring System can be bell, light, or other alarm. Specific identification and read out of trouble spots can be made manually (shown) or completely automatically.



Dotted lines indicate contents of "black box". Eighteen points being monitored (five points shown for simplicity).

ANOTHER EXAMPLE OF HOW **Fenwal** CONTROLS TEMPERATURE . . . PRECISELY

hydrogen bomb. There is nothing we can build to withstand a direct hit by a hydrogen bomb. But by being able to absorb a near-miss, you place a tremendous penalty on the aggressor. He must plan many missiles against each missile site to have a 90 per cent confidence factor that he will destroy it.

This would vary with the yield and accuracy of his missiles; but nevertheless, hardening is a very fine strategy.

Airplanes are a little different. Obviously, you cannot encase every airplane in concrete. Or I should say you can, but it would be expensive and it would slow you down. However, there are things we can do in the airplane field.

For one thing, we can "harden" communications. This is a different connotation of the word "hardened." Communications must be "backed up," so that, if the enemy destroys one form of communication, we are not completely cut off. Obviously, without communications, all I command is my desk, and that is not a lethal weapon. I must have secure communications in order to control the force.

Also, I must have warning which will come only through good communications.

An example of this is our base at Thule, one of the SAC bases near the North Pole.

I like to tell the commander at Thule that he will probably be one of the first ones to go if we get into a war, but that there is one thing I would like to know from him, and that is when he went. This might be very vital intelligence.

If our entire communications at Thule are right on the base, the bomb that knocked out the base would also knock out the communications. So by "backing up" I mean to place alternate communications outside the limit of the base, so that one bomb could not destroy the whole thing.

We have a good communications system in the Strategic Air Command, one of the finest systems in the world. We are constantly improving it. We have a new system programed which will be a dramatic step forward. I hope it will be funded and carried through, because the whole field of communications, both civilian and military, requires a lot of overhaul.

Modern weapons depend more and more on communications in order to become effective.

SAC Dispersal

I would like to leave the second area, hardening, and go to a third one, which is dispersion—dispersal of the force.

This is a very fine tactic for the obvious reason that, as we spread the force out, we increase the target system of a potential aggressor and thereby lower his confidence factor that he can strike all the retaliatory forces simultaneously.

The more we spread it out in numbers and depth, the lower his confidence factor. It is a very good tactic.

There is another thing it does which sometimes is not well understood, and that is, dispersion keeps us from being "runway-limited." An example of this is this: Supposing we had all our airplanes on one field and were told to go to war. Even if we had bombs in the bomb bays, pilots in the cockpits, and engines turning over, we could take off only 10 airplanes in 10 minutes or 60 in 1 hour, because we would be "runway-limited." By spreading out the force, we dramatically improve our reaction capability. This, too, is a fine tactic.

I have mentioned three things—sabotage, hardening, and dispersion. I would like to comment that these are all very good tactics, but they are defensive in nature and, by themselves, will not deter anyone.

The real backbone of SAC's deterrent posture is our alert system. As you know, under this system we maintain a certain percentage of the command on the alert 24 hours a day, 7 days a week, 365 days a year. Airplanes are loaded with bombs; crews sleep close by. They are tested every day—we can get them rolling in about 5 minutes, that is, the first airplane starts rolling down the runway in 5 minutes.

This is the only force that a potential aggressor knows he will have to reckon with, no matter how cleverly he plans his surprise attack. If that force is big enough, and if it gets the 15 minutes' warning for which it is tailored, and if it can penetrate, we think an aggressor will be strongly deterred.

I mention some if's. This force is built to meet the missile threat and not the airplane threat. It is designed to get off the ground in 15 minutes because it is technically feasible to get 15 minutes' warning of a missile attack.

If we get that warning, we can get these airplanes off the ground; therefore, even though an aggressor launches missiles against the United States—and nothing can stop them today—we will still get the retaliatory force off, that part of it that is on this alert; it will not be destroyed, and the aggressor will have to absorb it.

If the alert force is big enough—and again I say, if it can penetrate we think he will be strongly deterred.

There is some philosophy which underlies our actions. I think it would be helpful to discuss that philosophy with respect to the field of deterrence, which is really our mission, as it applies particularly to this last point I made. In a philosophy of deterrence, one of the fundamental points is that we certainly should be able to answer one simple question: Whom are we trying to deter? We are trying to deter Mr. Khrushchev and the Soviets. So it is perfectly obvious that, from a deterrent point of view, what he thinks of our capability is of paramount importance.

What we think of ourselves does not really amount to anything so far as deterrence is concerned. It is only what Mr. Khrushchev thinks of our capabilities that is important from a deterrence point of view. Therefore, he must be made aware of our strength.

I am not advocating that we hide our weaknesses; but let us not hide our strengths if we are to impress this man.

There is another thing that we have to be careful of, and I will express it this way: People sometimes ask me what I think the minimum deterrent force is. They ask as though it were a package that one would get at the local store and buy off the shelf with a price tag on it.

I tell these people, I don't know what the minimum deterrent is, and what is more, there is nobody in this world who knows.

If anybody tells you they know what the minimum deterrent is, tell them for me that they are liars. The closest to one man who would know what the minimum deterrent is, would be Mr. Khrushchev, and frankly I don't think he knows from one week to another. He might be willing to absorb more punishment next week than he wants to absorb today. Therefore, deterrence is not a concrete or finite amount.

There is a principle involved, a basic principle. I like to say, it is the same principle that governs you when you take out insurance on your automobile, in order to protect yourself against a civil suit.

Risky Business

Everybody has different amounts of insurance. I guess some people drive around without any liability insurance. That is their right, if they want to do that. It is a pretty risky business and depends on how much you have to protect and how secure you like to feel. These amounts of insurance can vary. I am sure the people in this room have different amounts of insurance, possibly because they have different values they want to protect.

However, you have to pay for what you get and you have to know what you are buying. I say that the same principle is involved in this business of deterrence. Nobody knows what the minimum deterrent is. The people of this country, if they want to, can do away with their Armed Forces and can live without any protection. I wouldn't recommend it, because I don't think they would be around very long.

Or you can strive for this minimum deterrent, which is a difficult thing to find and be sure of. Or you can keep going farther to the right as we believe we should do, and get a "deterrent margin."

If this margin is big enough, you could carry it to the point where even an idiot would know that, if he attacks this country, he would be literally and figuratively destroyed. Ruling out the madman angle, then we would have real deterrence.

Whether you want to go that far or whether you want to stop somewhere in the middle is the people's choice.

My point is that you can have anything you want, but you should know what you are going after.

Another basic principle that ties into deterrence is this: I know that some people in this country, if I told them right now that we have twice as many bombs and twice as many bombers or twice as many missiles as the Russians, they would go to bed tonight feeling secure. But they would have no business feeling secure. They just don't understand the problem, because it depends on who starts the war, who has the initiative.

Today, really for the first time in the history of the world, a tremendous advantage accrues to the man who strikes first.

Let me try to put this in mathematical terms. Let us take the Strategic Air Command right now, with which I am thoroughly familiar. I know how many airplanes we have and how many bombs. I know how long it takes to load them up. I know

FROM THE SILENT VASTNESS . . . a voice

Some tens of thousands of miles distant, from almost beyond the limits of belief . . . a voice. Zooming, pitching, yawing, hurtling, climbing, spinning, plummeting — the voice goes on, clear, unmistakable — telling a tale of wonders, extracting knowledge from the unknown, smoothing the way for others.

Providing a voice that will continue to speak — no matter how adverse the conditions — is but one of Radiation's jobs in the Telemetry, Data Acquisition, Radar, Automatic Checkout, Antennas, and associated fields.

RADIATION, INC.

MELBOURNE AND ORLANDO, FLORIDA
ASTRIONICS • AVIONICS • INSTRUMENTATION

IMPORTANT CAREER OPPORTUNITIES NOW OPEN. CONFIDENTIAL INQUIRIES INVITED.

Radiation's newly-improved 33-ounce FM TELEMETRY TRANSMITTER (Model 3115) has been proved successful in REDSTONE and JUPITER firings — and in many other missile, rocket-sled, and satellite programs.

- Completely miniaturized
- Crystal-controlled
- Frequency range 215-260 mc.
- Will support your most critical telemetry application

Certified tests have proved that this reliable, ruggedized unit is capable of operating under unusually extreme environmental conditions.

For complete information, write to RADIATION, INC. and ask for Bulletin RAD B-102.

Visit our booths at the IRE NAECON, Dayton, Ohio, and NTC, Denver, Colorado

what targets they will strike, and I know about how many people will get killed and about how many works of man will be destroyed.

We will call that capability "unity," that is, give it the No. 1. But since the Soviets will have the initiative, we are only in a retaliatory role and our capability will be greatly reduced.

Under conditions of retaliation, you have only a fraction of your force; namely, that part of your force which is on the alert and can operate within the warning time available.

If we had one-third of our force on the alert today—and that is our goal for the ground alert force—and if we had 15 minutes' warning against missiles, and if they could penetrate, then all we would have would be one-third of our force. So you see that, by passing the initiative, we have gone from unity, or one, to one-third. That is a combat-ready force which never has been maintained in the history of the world. No one ever has maintained a third of a military force on a 15-minute alert day in and day out. It never has been done. We think we can do it. We are approaching it now. We are a little over a year away. It was designed to meet the missile threat. We are going toward it and I think we will meet it, particularly if we continue some enlightened actions, such as the last pay bill. The last pay bill was a tremendous factor in stabilizing our force.

The point I want to make is that we never can maintain a high percentage on the alert as long as a high percentage of our force are trainees who, at about the time the training will pay off, leave the service. We never then can reach an adequate military posture.

Passing Initiative

You can see that, by passing initiative, we have upgraded the Soviet force by a factor of three, or turning it around, we have degraded our force.

Under the conditions, which are in existence today, you can place any number you want below this line—five, six or seven. For some forces, you could place 1,000 under there because, with the warning time available, it is doubtful whether they will ever get into action against a clever enemy.

Therefore, you can see that by passing the initiative—and this is just one of the basic principles—you negate the advantage of mere numbers. So there has to be something besides that.

That gets into another area which I would like to discuss—this fantastic compression of time which is not well understood by many people. Many people are living in the past. I do not say it critically because all their experiences have been in the past. They have World War II as the latest example.

They still think they will get warning, strategic warning, and it might be helpful for me to describe the two different types of warning in simple terms.

Strategic warning is that warning which is of sufficient duration that a military commander has time to get into fighting configuration and move into fighting position.

Tactical warning is of such duration that a military commander must fight from his present position and his present configuration. Those are the two classical types of warning.

I also maintain that we got our first strategic warning in 1848 when Karl Marx and Friedrich Engels published the Communist Manifesto. The Communists told us what they were going to do, and they have been doing it ever since. They are accomplishing their goal. They have taken over a third of the people in this world and 25 per cent of the geography.

If they are not stopped and just continue at their present rate, they will accomplish their goal of world domination.

Let us go back to Pearl Harbor. It was a surprise attack. In the back of people's minds, there is the thought that the Japanese initiated the surprise attack, and it was successful. But who won the war? They didn't win it—we did.

If you just stop there, you might downgrade the tremendous advantage of surprise. Let us look at the reason why Pearl Harbor was not decisive. There is a very simple reason:

The military fighting strength of the United States did not lie in Pearl Harbor in December of 1941. The fighting strength of the United States in December of 1941 lay in civilians in civilian clothes in this country and in factories turning out civilian goods. We built the U.S. Navy and we built the U.S. Army after Pearl Harbor. We had time to do it.

Today, that is gone. That went out the window when the hydrogen bomb and modern delivery systems such as the jet airplane and the missile came in. Today, it is possible to destroy a nation in a matter of hours and, in the very near future, it will be a matter of minutes.

This is what has happened to time, this compression of time.

We must understand that. Many people still think they will get word of an attack perhaps from Mata Hari or that the courier will drop a piece of paper out of his pouch. Or perhaps they will see troops marching onto ships and into planes, and they will thus get warning of an attack.

Today, you would not get such warning because modern weapons have made it possible to get a war started with little preparation. So you must understand what has happened to time, warning time.

Warning, tactical warning will come from radars. You must assume that the Soviets will take advantage of surprise in the initiative. I explained before numerically what happens when you take the initiative, and when you have the element of surprise. Therefore, I think it is a sound assumption that they will use this old tactic.

As a matter of fact, I think that, if you put an 8-year-old child in charge of the armed forces of any country, he would pick that tactic, because it is the oldest tactic known to man.

Under a condition of surprise—how do you get this warning? You get it from radars. Radar is a real fine device. The only trouble with it is that it sees too well. It sees things that are not there.

I would like to explain this to you because, in the position you are in, I know that you are faced with the problem of the relationship between missiles and bombers, and why we have to have a mixed force, at least for the foreseeable future.

As I mentioned, radars sometimes see things that are not there. Several incidents of this type have occurred during the last year at SAC Headquarters.

Whether or not the things the radar sees are real, you must assume that they are real and react accordingly.

That is why we designed this manned alert force to be always under what we call positive control. Although we have not yet done it, we can launch this force; I have the authority to do so. But, mind you, I do not have the authority to drop an atomic weapon. Only one man in this country has that authority, and that is President Eisenhower.

However, I can launch this force if I think there is an emergency. There is no harm done. A force gets off the ground immediately. Nobody but people in SAC would know that I sent it out. There are no sirens blown or anything. They are launched.

They proceed on course toward their targets. Unless they get an additional instruction from me, which is passed in a secure, fool-proof and safe way, they return home; that is, unless they are told to go on.

This gives the civilian decision-making machinery a gift of an hour and a half—at least an hour and a half—to make their decision, because I do not have to get in touch with this force for an hour and a half, and no harm is done for that length of time.

Within that time period, if I do not get the decision to go to war because the warning should prove to be spurious, the force starts "failing safe," that is, returning home.

This is why the manned force can live with these spurious signals.

Let me give you an example. Imagine it is a couple years from now. You know about the new missile-detecting radars, the "BMEWS," that are going in. Let us say the BMEWS are operational.

Let us imagine these BMEWS have been built, and it is 2:30 in the morning. The man operating the BMEWS has me on one end of the telephone and General Partridge on another circuit. The conversation goes something like this:

"The radars have picked up 1,000 objects. The computer says they are ballistic missiles, and they will impact in the United States."

I have about 12 minutes left because it took him at least 3 minutes to do that.

What am I going to do?

I can launch the alert force. I wish you were out at Omaha right now so I could show you our control center and how we can get these airplanes notified in a matter of seconds, which is all it takes.

I will use the "hot line" to send off these airplanes. I will do that without any hesitancy because I know that, if this turns out to be a spurious signal, no harm is done. At worst, it is a fine training exercise.

It can in no way cause an accidental war because nobody will really know about it. Certainly no Russian will know about it, because our aircraft would not approach Russian radars.

I will do this, as I said before, without

...NEWS IS HAPPENING AT NORTHROP

Now in production—the world's first space-age trainer—USAF T-38 Talon. Mission: to train tomorrow's airmen in the art of supersonic flight.

UNIQUE NORAIR MANAGEMENT METHODS CUTTING SPACE-AGE AIRCRAFT COST !

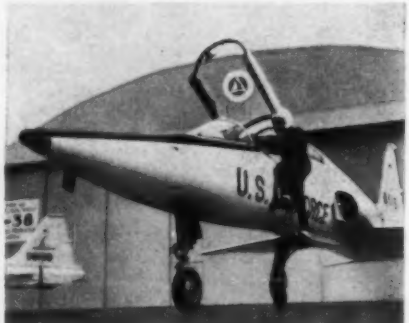
T-38 Talon is the first of Northrop's new family of high-performance, low-cost aircraft produced at Norair, Hawthorne, California. Using an inherently economical design as a base, Norair management is reducing costs even further by applying three Norair-created methods.

Pace – Performance And Cost Evaluation – is Norair's new way to measure group effectiveness. Its successful application to the T-38 program has created wide military and civilian interest.

Norair's Target Cost Control constantly monitors all areas of cost – from preliminary design to final assembly. Such a continuing control system keeps production costs at a minimum, assures maximum efficiency.

Years-Ahead Production Techniques utilize Norair's 20 years of airframe experience. In the area of honeycomb structures – for example–Norair-designed high-accuracy forming, contour milling, and adhesive bonding techniques trim T-38 costs – producing higher-quality hardware for less money.

Norair combines these and other management methods with its completely integrated research and development facilities. Result: earlier and more effective answers to the problems of free-world defense in the space age – at minimum cost.



NORAIR *formerly Northrop Division*
HAWTHORNE, CALIFORNIA
A Division of **NORTHROP CORPORATION**

any hesitancy. In this way, I will insure that this retaliatory force, the ground alert force, will not be destroyed.

But in this time period we will also have a button whereby I can send the ICBM's on their way. I will have missiles at Vandenberg Air Force Base, Cheyenne, Offutt, Fairchild, and—I don't know whether Topeka will be in at that time or not, but let us assume it is.

I can press that button and send the missiles on their way.

Do I want to do it, assuming I had authority to do so? Because sure as shooting, in another 2 or 3 minutes, this lad will say, "I am sorry, but those blips have disappeared off the scope." They were Sputniks, interference, or something like that. Therefore, I say the missile will have to ride out the attack.

I cannot see for the foreseeable future how we can launch them on the basis of radar detection alone. This is why their sites have to be hardened, and this is why they must be complemented with a manned bomber force that can get off the ground and insure survival.

Therefore, the manned bomber force insures its survival through getting warning and getting off the ground with that warning, while the missile force will have to rely on its ability to survive the attack. This is important when we consider the relationship between manned bombers and missiles.

Accidental War

There is one other thing that would be helpful to mention, and that is the problem of an accidental war which I think is one of the things that is important enough to discuss.

In our lifetime we have seen this happen: We saw Mr. Hitler misjudge our capabilities. He got overimpressed with his own strength. I think he misunderstood things he saw in our camp. I think he thought we were weak, gutless, and afraid to fight, and I think he had reason to arrive at those conclusions.

If you will recall, at that time we used to maneuver with trucks with the word "tank" written on the side in chalk. We had paper guns, and American youth was writing on the side of barracks "Ohio" which meant, "Over the hill in October"—If you don't stop this draft, we will quit on you.

I think Hitler saw all this, and he read it as a sign of weakness.

His belief in our weakness was strengthened further by the Munich agreement which made Mr. Chamberlain express the hope that we would have "peace in our time."

Unfortunately that peace lasted only 11 months.

I think all of these things added up—Hitler with his cohorts, his people, and scientists saying they were ahead of us. Goering told him "I will change my name to Meyer if they ever bomb Berlin." He didn't last long enough to get his name officially changed, but the important thing is that Mr. Hitler believed him. He felt he could take us. He felt he was strong, and we were weak.

He was wrong but a war is a hard way

CAL Viscount II refuels at Colorado Springs using underground Hydrant fueling system with REDA Jet Fuel Submergible Pumps.

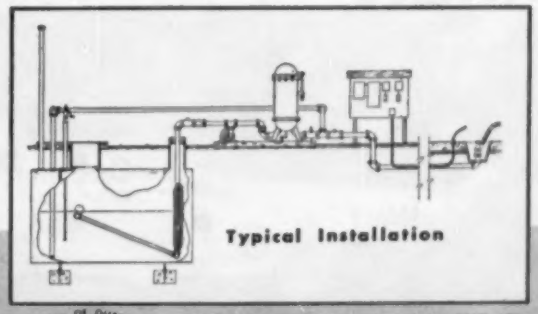
Last year, Continental Air Lines conceived the idea of using a manually operated underground hydrant system as a practical and economical method of refueling its new Viscount turbo-prop and Golden Jet 707 airliners. This system, utilizing Reda Jet Fuel Submergible Pumps, has proved to be less expensive in both installation and maintenance than a conventional fueling tender system would have been.

Continental's system uses a simple hydrant so located that an airliner can be refueled on the loading ramp. A 10 H.P., 220-volt Reda Jet Fuel Submergible Pump is installed in each of two, 10,000 gallon underground tanks connected by a common header. The fuel is pumped through the header to the filter separator, and then to the hydrant on the loading ramp. The pumps are automatically controlled at the hydrant by an explosion-proof remote switch located on the hydrant service cart. This cart is used to transport and store the aircraft fueling hose.

The performance of Reda Jet Fuel Submergible Pumps in these installations has been so sufficiently satisfactory that their use has been extended to several more double hydrant systems, at other Continental refueling points.

CHECK THESE IMPORTANT ADVANTAGES: UNDERGROUND INSTALLATION — no surface structures — NO EXPLOSION HAZARDS — U/L approved models — NO STUFFING BOXES TO LEAK — motor and pump in one unit — HIGH VOLUME AT REQUIRED OPERATING HEADS — for single or double underground hydrant refueling systems.

Contact REDA today for submergible pumps especially designed to meet the exacting requirements of underground pumping systems!

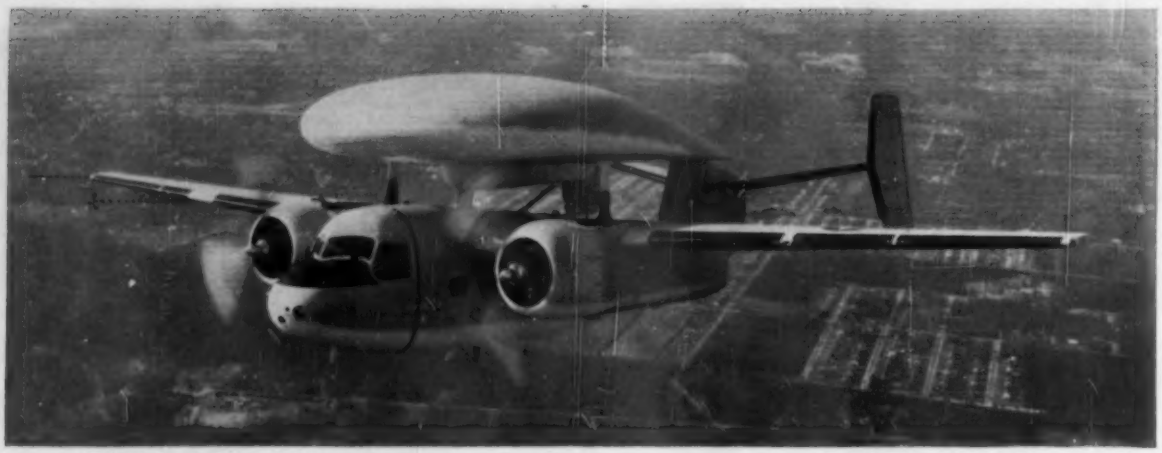


SIGN OF QUALITY SUBMERGIBLE REDA PUMPS

REDA PUMP COMPANY

BARTLESVILLE, OKLAHOMA

World's Largest Manufacturer of Submergible Pumps for Oil, Brine, Water, Gasoline, Jet Fuel, Chemicals and LPG.



GRUMMAN'S "SAUCER-TOPPED" WF-2 TRACER, early-warning airplane for Navy carrier operation, carries long-range radar detection equipment.

BENDIX 20 KVA GENERATING SYSTEM PROVES TREMENDOUS VERSATILITY

Here is a lightweight, transistorized, AC generating system that brings extreme dependability to its many applications. First developed for the USAF for one of its Century series fighters, the Bendix 20 KVA system will soon be flying for the U.S. Navy on Grumman's WF-2 and Sikorsky's HSS-2.

The Bendix system regulator will provide close voltage regulation and will hold transients to a minimum with rapid recovery. The protection panel will protect the critical aircraft components from under- and over-voltage and from under- and over-frequency.

Offers unusual effectiveness on missiles and on a wide variety of aircraft—in fact can be used on any engine-driven, air-driven, hydraulic-driven or pneumatic-driven application . . . either airborne or ground. Get further details from BENDIX AVIATION CORPORATION, EATONTOWN, NEW JERSEY.

West Coast Office: 117 E. Providencia, Burbank, Calif.
Export Sales & Service: Bendix International, 205 E. 42nd St., New York 17, N. Y.
Canadian Affiliate: Aviation Electric, Ltd., P. O. Box 6102, Montreal, Quebec.

Red Bank Division — Bendix Aviation Corporation

SIKORSKY HSS-2, designed for long over-water flight and low-altitude hovering—even alighting on water—during sonar anti-submarine missions.

to prove somebody is wrong. I maintain that we have elements of the same problem today.

I think Mr. Khrushchev's Sputniks and scientists are telling him they are way ahead. I am sure his air defense command people are telling him they are the greatest.

If there are any signs of weakness that come out of this country, I think this could become a very dangerous combination. So again I state that there is a danger of a miscalculation. These are the things we must become more sophisticated about because, as I stated at the beginning, deterrence is meaningless unless Mr. Khrushchev is impressed with our capability.

On the credit side of the ledger, based on information we are sure of, Mr. Khrushchev, as of this moment, is deeply impressed with the Strategic Air Command. He is real unhappy with the Strategic Air Command.

Our real mission, you might say, is to have that Russian planner get up from his table every morning and turn to Mr. Khrushchev and shake his head and say, "Today is not the day, comrade."

I think if we can do that we are accomplishing our mission.

I would like to leave one other thought with you, and that is this: The most important single factor in analyzing this problem is the answer to this question: How much warning do we have? Right this minute, in the next 5 minutes, tomorrow, next week, next month, next year? We cannot afford to brush this off lightly because we are risking the whole country.

Warning Guarantee

Responsible people must tell us what amount of warning they can guarantee.

The Strategic Air Command does not generate warning. We are customers for warning. Somebody else gives us the warning.

If you have no warning—zero warning—then ask yourselves the question, What can you do?

Mind you, I told you our alert force was geared to 15 minutes warning. However, suppose we had no warning? Suppose, he gets the missiles in quantity before we have BMEWS operational, or suppose BMEWS do not work out the first day they are in operation? Then what do you do?

Mr. Mahon. Off the record.

(Discussion held off the record.)

General Power. This warning is the crux of the problem.

We may not get any warning of a missile attack.

Mr. Khrushchev knows that, and he might feel that these are very favorable circumstances.

What can you do?

We in the Strategic Air Command have developed a system known as airborne alert where we maintain airplanes in the air 24 hours a day, loaded with bombs, on station, ready to go to the target.

This is a difficult way to live. A 40-hour week goes out the window. There are long, hard hours for everybody. It never has been attempted in the military history of the world before.

We have tested it, and we know we can do it.

I feel very strongly about it, because I think it is possibly the only deterrent force we will have during that time period.

I do not want to keep an airborne alert from here on out into the future.

The minute any responsible person in this country says, "I will guarantee you warning of this number of minutes," I would drop the airborne alert and tailor to it a ground alert, because it is an easier way to live.

However, I feel strongly that we must get on with this airborne alert to carry us over this period. We must impress Mr. Khrushchev that we have it, and that he cannot strike this country with impunity.

I think the minute he thinks he can strike this country with impunity, we will "get it" in the next 60 seconds. The only thing to keep him honest is full knowledge of what will happen to him.

Mr. Chairman. I have covered a good bit of time here, about 50 minutes.

Mr. Taber. Why don't you go on and finish the story?

General Power. I think I have told you the story and set the stage for questions. It would probably be most helpful . . .

Mr. Flood. You do not mean strike us with impunity. You mean strike at a point . . .

General Power. Acceptable to him.

Mr. Flood. Yes.

General Power. That is what I meant, yes.

Mr. Flood. Retaliatory damage?

General Power. Yes.

This is another important factor from a deterrent point of view: We should not think that what will deter us will deter him.

In this country, our idea of a disaster is based on our own experiences.

We had the Civil War—lost some 600,000 people.

We had World War I—less than 200,000.

World War II—we lost in the neighborhood of 300,000.

The Galveston flood about 5,000.

In the Chicago fire and the San Francisco earthquake we lost a far lesser number.

These are our experiences. To us, these are disasters.

However, we must realize that the Russians in World War II lost some 20 million people. They killed an estimated 9 million of their own people in deciding who owned the land.

Communist Liquidation

The Chinese, I am told—I don't know how authentic it is—but at least the Chinese Ambassador here from Nationalist China states that, based on his information, the present Chinese Communists have liquidated some 20 to 30 million Chinese. So, I think it is very difficult to say just what will deter Mr. Khrushchev, because he might be willing to accept punishment that we would not be willing to accept.

(Discussion off the record.)

I think the Soviet leaders have a very high regard for their own personal lives. But we must not be trapped into this feeling that very little damage will deter them.

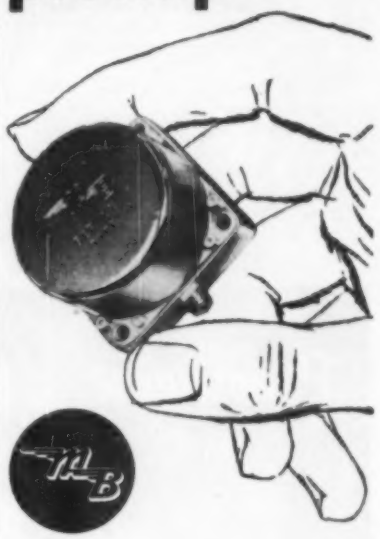
I believe this is the point you were making?

Mr. Flood. You might add the conduct of this individual Khrushchev in charge of the administration in the Ukraine.

(Discussion off the record.)

Mr. Mahon. General, you have made a very interesting and dramatic statement.

Advanced design in a vibration pickup



VIBRAMITE

New MB velocity-type pickup features all these performance advantages:

- Miniature—only 1.42" square x 1" high
- Weighs only 2.75 oz —accurate signals
- Eddy current damped—stable sensitivity
- Flat response from 30 to 2000 cps
- Takes 50g acceleration continuous — impact to 1000g
- Continuous —85° to +500°F range
- Omnidirectional — no adjusting

Bulletin #112 tells more. Write . . .

MB MANUFACTURING CO.
DIVISION OF TEXTRON INC.
1078 State Street, New Haven 11, Conn.

and a very impressive statement. In fact, in my long service on this committee, I have never heard a more impressive statement.

Mr. Norrell. Might I ask one question, Mr. Chairman?

Mr. Mahon. Yes.

(Discussion off the record.)

Mr. Norrell. The general has impressed me very greatly. I certainly am heartily in favor of your continuing to be Commander in Chief of the Strategic Air Command.

General Power. Thank you.

Mr. Flood. I want to ask you a question, Mr. Chairman. This is all off the record.

(Off the record.)

Adequate Deterrence

Mr. Mahon. General, you have talked about the necessity for having an adequate margin of deterrence so that we ourselves can be confident of its adequacy and so that the opponent could have no misapprehension as to its adequacy. Do we have an adequate margin of deterrence now?

General Power. As of this moment, yes.

Mr. Mahon. Do you think we will have it in 1960? I shall ask you for 1960, 1961, 1962, and 1963.

General Power. I think our deterrent posture is deteriorating.

Mr. Mahon. But you must go on from there to answer my question.

General Power. The rate at which it deteriorates will depend on our rate of progress in relation to the Russians. Let us put it this way: I think we are in a neck-and-neck race. You cannot win a race until you go over the finish line. I think it behooves us to assess the position of our opponent and take whatever necessary action is required to cross the finish line first.

Mr. Mahon. My question is, in 1960, during the year 1960, thinking also of the end of the year 1961, and the year 1962, and 1963, according to present plans as you know them will we have an adequate margin of deterrence in those years?

General Power. I cannot guarantee it.

Mr. Mahon. I think you could speak pretty authoritatively of 1960.

General Power. I know what our capability will be, but the unknown is: What is the Russians' position? This is a weak area. How much do we know about the Russians?

Mr. Mahon. You have studied the intelligence reports, and so forth, with respect to the Soviet capability in bombers and missiles, and you ought to know.

(Discussion off the record.)

Mr. Mahon. I think you have made a good response. Let me pursue this a little further. It has been my observation that nobody can tell unequivocally and with complete assurance just what the situation is within the Soviet Union with respect to their present capability and their prospective capability. We have educated guesses. Do you have considerable confidence in these educated guesses?

General Power. One of our weakest areas is the little information we have to work on. If there is anything that needs emphasis in this country, it is the ability to get more information about the Russians, and particularly their missile capability and their position in this missile race.

Mr. Mahon. Under those circumstances, what are we to do? That is what troubles us. We do not want to be caught short. What are we to do with respect to this problem?

General Power. Most of this, of course, gets in the realm of things to come.

Mr. Mahon. Yes.

General Power. I think you should make sure that you support and support vigorously some of the new developments, particularly in the space field.

Mr. Mahon. Do you have an opinion on the question of whether or not we should press forward more expeditiously with the building of the Atlas missile? It is not presently planned to use our fullest capacity to produce the liquid-fueled Atlas missile. Are you willing to follow a more or less conservative course on the Atlas and go forward as rapidly as possible to the Minuteman, which is a more reliable and flexible solid-fueled missile, and rely on your manned bomber force? How do you feel about that problem?

General Power. I will try to paint the picture for you.

Let us face it. The major share of the deterrent posture of the Strategic Air Command today rests in the B-47 fleet. This is the six-jet-engine, Boeing airplane. This airplane is approaching obsolescence now, and it is approaching the state of being obsolete. This airplane is not the one-horse shay. It cannot last forever.

To modernize an obsolescent airplane is quite a problem.

Mr. Mahon. Have you solved it adequately?

General Power. We have solved that problem to a degree. But when you start beefing something up, you merely prevent it from breaking there. But you do not know whether you are just passing it somewhere else down the structure. We have arrived at estimates of the life of this airplane. This is one thing which is nobody's fault. High-speed jet operation is a new art. There isn't any background. There are no textbooks to which you can go to get the answers. Some very comprehensive tests have been run. They are not conclusive and are not finished. They are continuing.

B-47 Replacement

What can we replace the B-47 with? We can replace it with B-52s, B-58s, and missiles. We should replace the B-47s as fast as we can, in order not to have our deterrent posture deteriorate.

Mr. Mahon. With the B-47 requiring refueling and requiring some operation from overseas bases, you have to take into consideration the probable availability of the operational IRBM to the opponent. Can you still rely on the B-47 even though it remains structurally sound, and so forth?

General Power. With the tanker fleet, the B-47 is in the war plan, and a good percentage of it goes from the United States. We have a percentage overseas which is less secure. To answer your question—the B-47 can operate from this country and strike targets in Russia.

Mr. Mahon. The question was, what

Performance proved in flight
You can get up to a 10% increase in propeller efficiency by selecting the new Sensenich . . .
FIXED PITCH METAL
CAA approved up to 165 hp
Also available from Sensenich . . .
FIXED PITCH WOOD
CAA approved up to 225 hp
TEST CLUBS
up to 3000 hp
See your nearest Sensenich distributor or dealer or contact the plant.
Dept. W, Sensenich Corp., Lancaster, Penna.
Sensenich PROP SHOP . . . Certified Repair Station for all makes fixed pitch metal or wood propellers . . . Sensenich, Beech, Hartzell and McCauley controllables. Magnaflux, etching, anodizing and plating service available. Service Hangar on Lancaster Municipal Airport. Approved Propeller Repair Station 3628. Unlimited Class 1 and 2 ratings. Distributor of Hartzell propellers and parts.
AIRCRAFT
SENSENICH
PROPELLERS
Sensenich Propellers
SERVING THE AIRCRAFT INDUSTRY FOR MORE THAN 25 YEARS

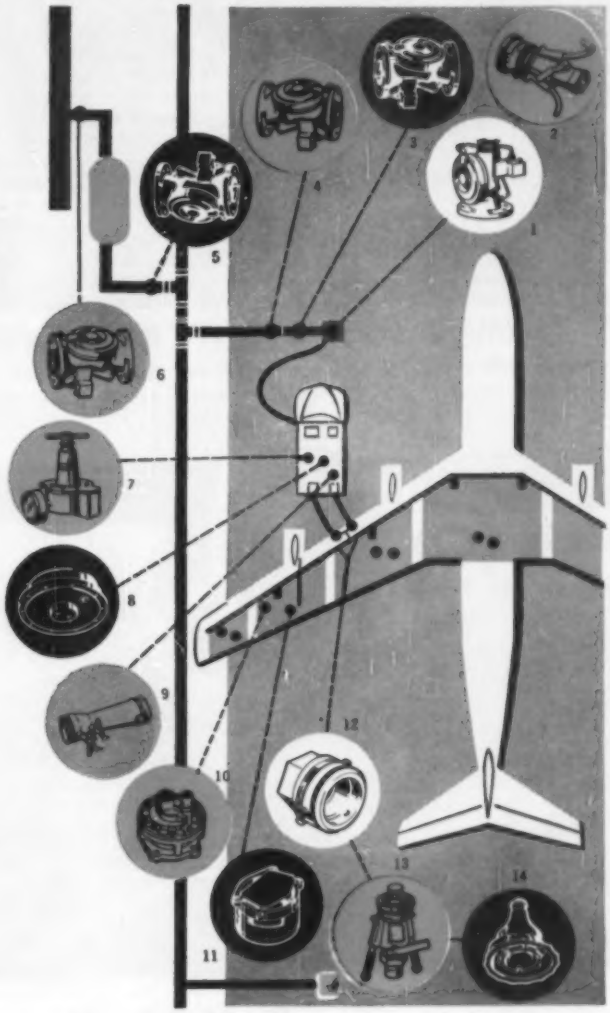
PARKER AIRCRAFT CO. FLUID-SYSTEM COMPONENTS

for GROUND FUELING integrated with AIRCRAFT FUELING SYSTEMS

Parker knows best!

Parker alone has used its back-up experience in AIRPLANE FUEL SYSTEMS *to develop and perfect* GROUND FUELING SYSTEMS.

Parker ground fueling components embody the same precision design standards and rugged reliability demanded of internal aircraft fuel systems. Parker **nozzles, adapters,** and **control valves** are ideally suited for use on tank trucks, hydrant fueling vehicles, bottom loading of tank trucks and many other compatible **ground installations.**



1. Pressure Control Valve
2. Hydrant Coupler
3. Shock Lock-out Valve
4. Pressure Reducing Valve
5. Slow Open/Slow Closing Check Valve
6. High Level Shut-off Valve
7. Air Regulator
8. Water Sump Control Valve
9. Venturi
10. Level Shut-off Valve
11. Level Float Valve
12. Quick Disconnect Swivel
13. Underwing Fueling Nozzle
14. Underwing Adaptor

For further information on the Parker integrated fueling concept, send in this coupon.

to know Aircraft Fueling... know PARKER!

Parker Aircraft Co., 5827 West Century Boulevard, Los Angeles 45, California, Telephone SPring 6-1221

Parker Aircraft Co.
5827 Century Boulevard, Los Angeles 45, California

Please send me information on the Parker integrated fueling concept, and specific data on the following:

- ☐ PRESSURE CONTROL VALVES
- ☐ NOZZLES AND COUPLERS
- ☐ BOTTOM LOADING OF TANK TRUCKS
- ☐ AIRCRAFT GROUND FUELING

Name _____

Title _____

Company _____

City _____ Zone _____

State _____

A SUBSIDIARY OF PARKER-HANNIFIN CORPORATION

shall we do about this situation? Can we afford to rely on the B-47 and the B-52 and the more or less modest budgetary program for the building up of additional striking power? That is the question. Shall we try to do something more about it than we are doing?

General Power. If you are asking me, the answer is "Yes." I want more B-52s than are in the program, and I want more Atlases—and I want them faster—and I want more B-58s.

Mr. Mahon. I know you want them, but is it sufficiently important that we do something about this?

General Power. I think you are just risking the whole country. That is how important I feel it is. If you do not deter this man, as I said before, nobody is going to win a thermonuclear war. So it is a tremendous challenge to stay out of it.

Mr. Mahon. We have the B-47s and quite a number of B-52s and a few missiles. Will that be adequate for this period of two or three years?

General Power. Your adjectives do not pin it down, but I will pin it down. The force which is now programed—which I am told by the Pentagon is programed—is not adequate because it is not coming fast enough.

I want more, and I want it faster. I have so asked for it.

Mr. Mahon. There are people in this country who feel that we have gone hog wild on deterrence. They point envious fingers at the Air Force which rides high and wide. They have maybe a feeling of some jealousy in regard to the Air Force. The Air Force gets the lion's share of the money. There are many who feel that we have pampered this Air Force baby too much. Do we have too much deterrence?

General Power. Let me answer that question a little differently. These are my figures, and anybody can quarrel with them because these are hard figures to get. According to my estimates, some 18% of the defense dollar goes into the Strategic Air Command. We carry over 90% of the deterrent responsibility. Over 90% of the TNT equivalence in the war plans of all of our Armed Forces and all the allies is carried in SAC bomb bays. If that is babying and pampering, I do not agree with them.

Mr. Mahon. I believe you have answered the question: You do not think we have placed too much emphasis on deterrent power.

General Power. No. I think there is a tremendous challenge today to stay out of this war. I think man will have reached his highest plateau of stupidity if he gets into an all-out thermonuclear war. I agree with this deterrent role. I think it is the height of stupidity to get into a thermonuclear war in which millions of people will lose their lives. All I say is, let us not cut it to a fine edge. Let us make sure that we talk from a position of overwhelming strength. There is not any other answer as far as I am concerned.

Mr. Mahon. Is it not true that with relatively few hydrogen bombs you could more or less destroy any country without necessarily hitting their strategic bases? What is your approach to that? In other words, there are some who say all you need is to drop a few hydrogen bombs and you wipe out millions of people and destroy the country. They can still hit you, but they cannot afford to take the risk because they cannot accept the damage which you can give them with a relatively small counter-offensive capability.

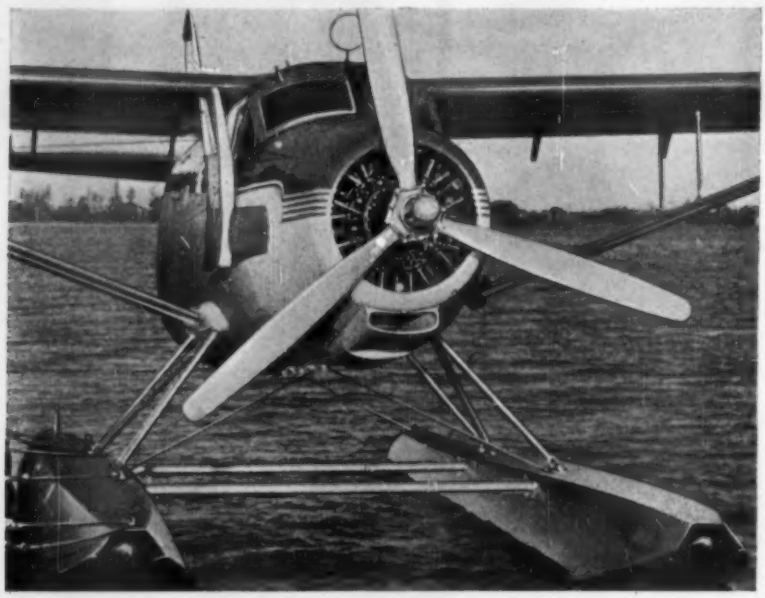
General Power. If you will get this gentleman, whoever he is, to tell me what Mr. Khrushchev will not accept in lives and in the works of man destroyed, then I will tell you exactly how many weapon systems and how many bombs it will take to destroy him. But nobody knows, that is the point. When this person says that only a few bombs will deter him, he does not speak from knowledge.

Mr. Mahon. That is the argument I have heard.

General Power. Off the record.

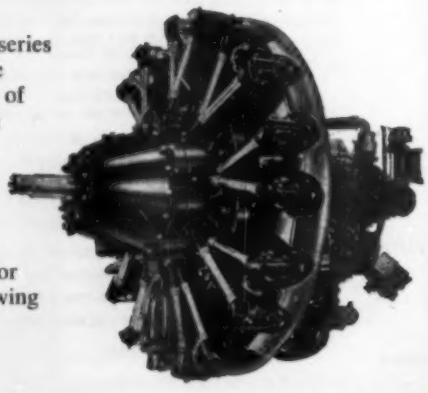
Mr. Mahon. The question which we are wrestling with—and it is a little vexing to know how to approach it—is whether or not we have an adequate margin of deterrence now and whether we have an adequate margin of deterrence planned for the next few years. I want some help there, and I am getting a little from you. Can you give us any more?

General Power. I will try it again. I appreciate that this is a tremendously complex problem. Let me state that, even living with it all day, it is difficult to understand it, because you start changing a few values and you can just get lost in the woods. It is a difficult problem. All I can try to do is



Compact–Reliable Power

The Alvis Leonides 530 series engine provides a reliable and compact power unit of 600/625 B.H.P. with an overall diameter of only 43 inches. Developed from the Leonides for many years the trainer power unit of the Royal Air Force it is available for installation in both fixed wing aircraft and helicopters.



ALVIS LEONIDES AERO ENGINES

ALVIS LIMITED • COVENTRY • ENGLAND

to give you my honest opinion: There is no doubt that we have a deterrent margin today, and the record is the best proof. We have not been in an all-out thermonuclear war, and there is no better proof than that. You have a deterrent margin today.

Will you have it tomorrow? Will you have it in 1960, 1961, 1962? I say our deterrent position is deteriorating because of the coming of the missile era, which is bringing a host of new problems and further compressing time.

(Discusion off the record.)

Mr. Mahon. General, many people are downgrading all-out nuclear war because they say that we are in a stalemate position, and the thing that Congress and the country ought to do is to get ready to fight little wars, because little wars might blossom into big wars, and spend more money on little war capability. It has been boasted that maybe 60 per cent of the budget for Fiscal 1960 is quite closely related to limited war capability. I would like your comments on that question.

General Power. First let me state that a tremendous disservice, in my opinion, is rendered the American people when people say there is a nuclear stalemate. Nothing could be farther from the truth. There is no nuclear stalemate. As I said before, it is a very fluid situation. We have the deterrent posture today. We can lose it tomorrow. There are so many variables in this thing. It is not a block of concrete. It is actually very frail. Our position of strength today is the result of action people took 5 and 10 years ago. Those were the lead times to get into this position today.

The action you are taking today will probably not affect too much your deterrent posture today or in the immediate future, but it will assure it in the more distant future. So I think that there is no such thing as a nuclear stalemate.

Mr. Mahon. Now answer the rest of the question.

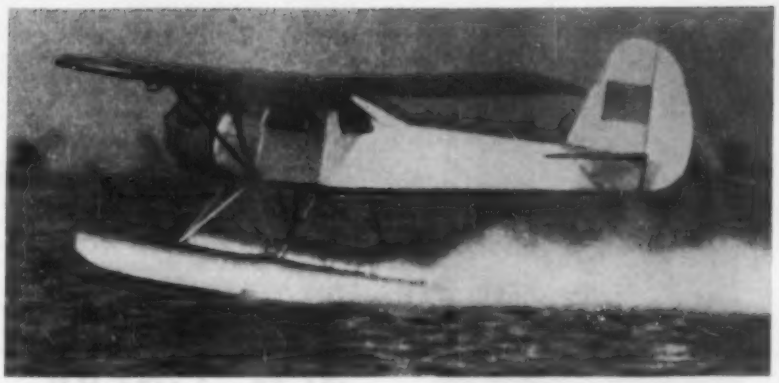
General Power. That is the first part, which I think is tremendously important. Will you restate the other part of your question?

Mr. Mahon. The other part is this business of emphasizing the small war.

General Power. Let me state that I think you should deter small wars as well as big wars, because obviously, if he can just take us over bit by bit, he will accomplish his goal. I think we can deter small wars. I think the action in Lebanon and the action in Quemoy were very fine. They were helping our deterrent posture. These were real actions to deter war. The reason we could prevent those actions from expanding is that we had the Strategic Air Command backing these forces up.

Quemoy was even better than Lebanon, because here we took a firm stand for a pile of so-called useless rocks. But it was notice to the world that this country stands for something, that we have principles and oppose the principle of blackmail through military force. If we were willing to stand up and risk war for some so-called useless rocks, what better proof could we give of our determination to stand up to a more serious incident?

On the question of whether we are putting all our effort into small wars or big wars—as I said before, in my opinion a very small percentage of the defense dollar goes into the Strategic Air Command—about 18% of the dollars, less than 10% of the men and the real estate, about 7% of the airplanes, a fraction under 5% of a lot of other resources. So I maintain that we have about 83% of our effort, dollarwise, and over 90% of our total effort really aimed at small wars, plus the fact that the Strategic Air Command has a tremendous capability to participate in small wars. This is where you go down this primrose path of what is a small war. I should like to ask, when is a small war not a small war? SAC and its airplanes can carry any yield weapon. A bomber does not care what it carries. We have forces on the alert, and we will carry bombs any place as long as somebody in authority says, take them there and names the geographical coordinates of the targets. We have a tremendous capability for small wars in the Strategic Air Command to back up the other forces.



Red Chinese Build Flying Dragon Seaplane

Flying Dragon I is the designation of this high wing seaplane, built by Red Chinese technicians at the Mechanical Factory Feilong at Shanghai, China. Chinese claim that the aircraft was built in 48 days. It is designed to carry four passengers.

Small War

Mr. Mahon. Your statements are interesting, but they have not given me much help on how much emphasis to place on small war preparation. I would like the witness to try to give me a little more help here, if he can.

General Power. Whether we should have a bigger Army?

Mr. Mahon. No, I do not want you to talk about that specifically. That would get you into other problems on which you probably should not comment. Should this committee go in a big way for much larger attention to small wars? People are unhappily saying that we are not in any way adequately prepared for small war. We have the big punch, but we cannot do much about small war. So forget the big punch for a few minutes, and fix us up here for small wars.

Mr. Flood. Or should we keep what we have?

General Power. I am sorry I am not helping you, but I maintain that we have sufficient Armed Forces to tailor a force to handle any small war. Again, if you are going to carry on a small war like the one in Korea or even bigger than Korea and still label it a small war, then I start differing with you. I say you can limit the size of a small war only until the time one of two parties decides it does not want it to be a small war any more. One is Russia and the other is the United States. So it is a question of how big is a small war going to be before you declare it is a big war. You have the right to do it at any time.

Mr. Mahon. Mr. Sheppard has a question at this point.

Mr. Sheppard. I was trying to coordinate my thinking and ask the gentleman this, which to me it obvious; if you are capable of mastering a global situation, then is it not rather obvious that you would be capable of taking care of a small war?

General Power. In my opinion, it is.

Mr. Sheppard. Why put emphasis on a backyard operation when you have a city block to deal with.

General Power. I agree with it. I stated we have a force which we can tailor to meet any small war. I think we have it.

Mr. Mahon. I would like the record to show just what the Strategic Air Command can do in a small war.

(Off the record.)

Mr. Mahon. Give us something for the record, and then amplify it, because I am a little bit hazy in that area.

General Power. I will rule out what I will call a police action where you have a policeman on the street directing traffic or maintaining law and order. A war, big or little, is when somebody is getting killed or something is being destroyed. Let us face it. There is nothing nice about a war. It just means those two things: Killing, or destroying the works of man. Somebody has to make up his mind whom he wants killed and what he wants destroyed. I am assuming you have somebody who knows whom he wants killed and what he wants destroyed.

I maintain that when it comes to delivering bombs—a bomb is just another word for killing and destroying—SAC can do it better and cheaper and quicker than anybody in this world right this day, in any quantity you want. Without reservation, I make that statement.

Mr. Mahon. You can drop the conventional bombs, and so forth?

General Power. Conventional bombs,

A-C Linear Accelerometer, Type LA-600, for aircraft and missiles. Shown actual size.

NEW LINEAR ACCELEROMETER

FEATURES FRICTIONLESS OPERATION

for greater accuracy, ruggedness and reliability

NEGLIGIBLE CROSS COUPLING

A-C VARIABLE RELUCTANCE PICK-OFF

MAGNETIC DAMPING

OPERATING TEMPERATURE -65°F to +250°F

NO WARM-UP TIME REQUIRED

HERMETICALLY SEALED

In the Honeywell A-C Linear Accelerometer, Type LA-600, friction introduced through bearings and potentiometer slide wires is eliminated. This unit consists of a non-pendulous seismic mass supported on a frictionless spring suspension and incorporates an a-c variable reluctance type pick-off.

Inherently insensitive to cross-coupling accelerations both when at null and when at an acceleration along its sensitive axis, the Type LA-600 also features magnetic damping for near-constant damping ratio throughout its wide range of operating temperatures. Mechanical stops prevent damage from input accelerations beyond the specified full scale range. Write for Bulletin LA-600, Minneapolis-Honeywell, Boston Division, Dept. 11, 40 Life Street, Boston 35, Mass.

Honeywell

H Military Products Group

DESCRIPTIVE DATA

FULL SCALE RANGE:	±0.5 to ±40 G
FULL SCALE OUTPUT:	Up to 10v, 400 cps into 100 K load; Up to 8v, 400 cps into 10 K load
THRESHOLD-RESOLUTION:	.0001G
CROSS-AXIS SENSITIVITY:	.005G maximum
VIBRATION:	10G, 0-2000 cps
SHOCK:	Up to 60 G
WEIGHT:	1.2 pounds maximum

very low-yield weapons, all the way up to multimegaton weapons. I do not maintain a posture to drop conventional bombs. But I can convert into that position very rapidly in a matter of hours. As an individual, I hope they will never call on the Strategic Air Command to drop conventional bombs, because we have so much capability in tactical airplanes, and there are other people who should be able to drop a few conventional bombs. I think if we get into a war which is not a little tiny police action, I do not want to see us use conventional bombs, because I have a deep moral sense as it applies to Americans. I get a little indignant with people who become very lofty in their thinking and do not want to kill a few of the enemy but would gladly risk additional American lives. My crews are more important to me than the enemy. If I can send only one airplane over and do the job of a thousand, that is what I want to do.

So I maintain in a certain type of small war we should use nuclear weapons.

Mr. Mahon. General, always we have those in our country who are on the alert, who are more concerned than others as to the extent of the danger. At least they see more danger on the horizon than others. They look at our Defense Department and they wring their hands, and the press carries stories as to the degree of our weakness. We all have a responsibility to try to tell the American people what the truth is insofar as it safely can be told.

Do you think our statements about the fact that we will probably be behind in ICBM capability in the next few years or statements of that sort are making your job worse, or what should we do about it?

General Power. Let me take the first part, the premise of giving the American people all the facts. I happen to feel very strongly about this. I do not think we will ever solve this problem until the American people understand it and are willing to do something about it. The military and the politicians are not going to solve this problem by themselves. It is the American people basically who are going to have to solve it.

To get this word to the people is very difficult because it is so complex. The only way you can do it is by a difference of opinion. You talked about the people who worry about our defense and the people who do not worry. I think this is what makes democracy tick. I think you have to get the issue out and let the two differences of opinion be aired. If there is any logic in either one, it will stand up. This is the only way we make progress.

Mr. Mahon. You do not think this procedure, which is of course the democratic way, gives aid and comfort to the opponent?

General Power. A certain amount. It is bound to. Any information would give a certain amount. I think it also works the other way, because wars start through weakness, not through strength. I think if the American people give indications of determination and strength, this is the greatest deterrent that you can develop today. So I think if you are going to lean, lean toward an informed public.

Mr. Taber. I wonder if the chairman would yield for a moment.

Mr. Mahon. Mr. Taber.

Mr. Taber. It seems to me we are getting at this without proper information. I shall ask three or four questions at once, and I am going to ask the general to answer them.

How much do you know about the Atlas? As I understand it, it has been tested so that it will carry a warhead a good distance, even to 5,000 miles. If I am getting anything in the record which ought not to be there, it can go out. But it is propelled by a liquid-fuel engine which the scientists say is not the best. Therefore, in making up this budget, the Department has passed up producing a lot of Atlases in favor of the proposed Minuteman which will operate with solid-fuel engines, which is said to be a better proposition.

I think in order to get at whether we should buy more of the Atlas, we should know something about the possibilities of the Minuteman coming in and being available and how soon it is going to come. What can you tell us?

Atlas Capability

General Power. You asked first the question, did I know anything about the Atlas? The answer is "Yes." The Strategic Air Command will operate the Atlas. It is our weapon system.

Also, I was in command of the Air Research and Development Command for 3 years, where we started the Atlas and had the responsibility for it. So I think I do know something about it.

You asked the question, I believe, should we defer action on the Atlas or have a reduced program because the Minuteman looks better and is coming in in a little later time period. I will give you a direct answer. I think you should produce the Atlas at the maximum logical, practical rate, because you are going to get it first. It is the only ICBM weapon system that has really fired up to now and it is a good weapon. It is almost a proven weapon. It has had a very successful R&D. But read the papers, and you would think the missile had been unsuccessful. Actually, it has been more successful than we ever expected it to be. It has had a very high degree of success.

I think we ought to get it as fast as we can, and get it in hardened sites. I think it is a very good deterrent weapon system.

Does that answer your question, sir?

With the Minuteman, you enter into a new era, because it is a solid-propellent missile and requires very few people around it. You can store it for about a year. This is a different philosophy of deterrence. This is really the philosophy of deterrence in that we will have so many of these missiles. Due to the fact that they are cheap and require very few people around them, we can get them in large numbers. Then it becomes mathematically impossible for an aggressor to destroy them all, and you will always survive with a percentage high enough to strongly deter him. That is the philosophy of it.

Mr. Taber. That is the philosophy of the Minuteman.

General Power. Yes. This is very good. Also, it takes the criticality out of this warning with which we are now faced. It is also possible, for example, to put Minuteman—these are things that we are technically considering now—on trains and have them moving. You could do this and actually get it very early, just as early as you could get hardened sites. Have a certain percentage of them moving on the railroads of this country. Now you have a moving target system, and an aggressor never knows where it is.

It is the same basic principle, you might say, and even to a better extent than the Polaris missile, which goes in a submarine which is moving. So that is a very attractive feature of the Minuteman.

Did I answer your question, sir?

Mr. Taber. Except this: The Atlas is a liquid-fueled missile. How much trouble can you expect operationally with the Atlas because of the liquid fuel?

General Power. Based on its R&D successes, I do not think we shall have too much trouble with it. We have in SAC a base, Vandenberg AFB, which is one of my bases, with SAC crews. We have fired an IRBM from that base with operational crews. I am talking from first hand knowledge. I think we will have a good reliability factor and will not face insurmountable problems. It is much less complex than an airplane, really. The beauty of the Minuteman is that it requires no one to attend it. It is almost like putting the missile in a cocoon. Nobody has to do anything to it, while an Atlas requires tech

Kawasaki Delivers Final T-33A

Last of 210 Lockheed T-33A jet trainers built for Japan's Self-Defense Air Force by Kawasaki Aircraft Co. is delivered at Tokyo, officially ending a project that cost about $50 million, shared equally by U. S. and Japan. First batch was delivered in 1957.

AMPHENOL *Quick-Crimp*

BNC CONNECTORS

CUT ASSEMBLY TIME *IN HALF!*

AMPHENOL's new *Quick-Crimp* Series BNC connectors* obsolete just about every other BNC now on the market. Here's why:

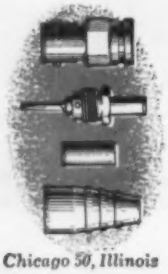
1 QUICK ASSEMBLY Only three basic parts (plus an optional boot) for you to assemble and crimp, as compared to as many as ten parts in a standard BNC! Assembly time is cut in half!

2 INCREASED RELIABILITY Critical assembly operations have been eliminated; inspection is easier, faster, reliable. Cable retention and strain relief is greatly improved. Connectors are weather-proof.

The *Quick-Crimp* family consists of 19 connectors: Plugs, Right Angle Plugs, Jacks, Bulkhead Jacks and Cable Terminations. *Quick-Crimps* mate with standard BNCs. Center contacts are gold-plated, have AMPHENOL's patented captivated contact** construction. Voltage rating is 500 V. peak. VSWR is low up to 10K mc.

*U.S. PATENT PENDING **U.S. PATENT 2,870,420

Body Assembly, Ferrule Clamp
Nut Assembly, Outer Ferrule and Boot
—Only Four Parts to Assemble!



AMPHENOL CONNECTOR DIVISION

AMPHENOL-BORG ELECTRONICS CORPORATION *Chicago 50, Illinois*

nicians around it all the time.

Mr. Taber. How close to fruition is the Minuteman?

General Power. Of course, it is really early in its development life, and I am not the man responsible for producing it. But I would say we could have the Minuteman along toward the end of. . . . But you see, we will have the beginning of an operational capability for the Atlas in the Strategic Air Command in July of this year.

Mr. Mahon. Did he answer your question?

Mr. Taber. I think so. . . .

Mr. Mahon. How essential is the Titan missile to SAC operations?

General Power. I think the Titan is very essential. One of the main attractive features of the Titan is that it lends itself to improvement in design.

Mr. Mahon. We know about that.

General Power. Increased yield, increased distance. This is something which could become tremendously important.

Mr. Mahon. What would you think about leapfrogging the Titan and going to the Minuteman?

General Power. I have been through this, and we recommend against it. We recommend that you actually produce the Atlas and Titan now as fast as you sensibly can to get them into hardened sites.

Mr. Mahon. What are the specific targets that require or will be assigned to Titan?

General Power. With all missiles, when we arrive at the yield which is now estimated—we know about how many megatons they will deliver and we have assumed accuracies—there is no problem in assigning targets to them. We assign the targets in Omaha, in my headquarters. We probably will compute the trajectories of all missiles. This is a very complex business. We do all the arithmetic there because in all these missiles you have to set dials which make this missile go from here to there. We live with this targeting day in and day out. There is no problem. There are ample targets for the yield and the accuracies that the initial Atlas and Titan will have.

Mr. Mahon. How do you plan to handle these targets at the present time? You have answered that in part. You can amplify that.

General Power. The Atlas and Titan will come directly under my control. Who will control the Polaris is undecided at this time.

Mr. Mahon. Can these targets be handled by Atlas, Thor, Jupiter, and Polaris, without the use of Titan?

General Power. No, because, you see, Thor and Jupiter are IRBMs. They do not have the range.

Mr. Mahon. I know, but we will have them overseas.

General Power. You have to tell me whether they will survive overseas and whether I can fire them, you see. The only real deterrent is what you have here on your own real estate under your own control. I am not saying you should do away with the other, but your strongest position is when you have control of it, and it is on your real estate.

Mr. Mahon. How will you handle these targets after Minuteman is available?

General Power. There is always a shifting of targets, but basically the target system is

arranged almost, you might say, in order of priority. In other words, if you had only one bomb and you could get only one missile off, what would you put it on? It is not so simple that you can do it just that way but, generally speaking, that is the way. Obviously, on our most important targets, we have to tailor the yield to the size of the target and the highest degree of probability of success. All our weapon systems even today are competing for each one of these targets in their order of priority. So I just cannot give you a pat answer except that there is a formula now in being that we would apply against this. It would be a routine job in which we really are engaged every day.

Mr. Mahon. Do you have all the essential targets in the Soviet Union covered with the present weapon systems?

General Power. We have all the target systems in Russia covered that we are capable of reaching. Of course, there are qualifications. It depends upon how much force I have. If I generate the whole force, I can reach so many targets. If I operate under the condition of retaliation, where I get only the alert force off, then it is a much smaller number. But I have the capability to reach any target in Russia.

Mr. Mahon. Do you have plans, in the event of war, to cover all essential targets?

General Power. It is a play on words, on "essential." I think so, yes.

Mr. Mahon. What reduction do you plan in the weapons systems with the advent of Atlas, Titan, and Minuteman as they come along? What are you going to do by way of reducing other weapons systems?

General Power. I think you should reduce and get rid of the obsolescent systems. I certainly would like to phase all the B-47s out. This airplane, let us face it, will be 10 years old in 1962, and as a rule of thumb, we have never had a 10-year-old airplane in the first-line inventory. It takes seven years to obsolescence and 10 years to obsolete. The B-47 comprises the bulk of our force. I would like to phase out the KC-97s. I would like to phase out the Snark. All weapon systems go through a period of erosion. All of the systems you mentioned—the new ones—I expect would have a useful life for about the span that you would expect of the average weapon system.

Long-Range Bomber

Mr. Mahon. What about the long-range bomber? To what extent will the long-range bomber be supplanted by the Atlas, Titan, and Minuteman?

General Power. The exact degree we will not know until we have operated both of them. I tried to give you in my opening statement the feeling of why you need manned bombers. We are phasing the bomber force down now. We are not putting the missiles in in addition to the bomber force. We are retiring bomber units and converting them into missiles. So there is an interplay between the two now. The exact ratio. . . .

Mr. Mahon. Is there a sensible plan in operation which takes into consideration the poor taxpayer along with the matter of his security?

General Power. Let me assure you that, even though it is not our responsibility, we have to understand the economics of this thing. I think in the Strategic Air Command—you can use any yardstick you want, you can use business yardsticks, percent in management or anything else—the taxpayer is getting 100 cents out of his dollar in Strategic Air Command fighting capability. You can use any yardstick that you want on that.

Mr. Mahon. How essential is the Snark missile to SAC operations?

General Power. Snark, due to its performance limitations, is, you might say, less essential than any of the weapon systems you have mentioned—the Atlas or the Titan. It is a subsonic missile system. Let's face it, it came in late. We are buying only a very few of them. They have a very limited value to SAC.

Mr. Mahon. We spent a lot of money on them. I wonder why you do not recommend that maybe we abandon it.

General Power. The decision to abandon them is not mine. You asked me how important they are to SAC, and I have said they are of limited value. Let me put it this way: of lesser importance.

Mr. Mahon. What targets are assigned to the Snark missile?

General Power. The Snark is not operational yet. Again, when we get it in being, it has a very poor reaction capability. From the deterrent point of view, it cannot get off in these short time periods that I mentioned unless we had sufficient warning. Therefore, you would have to give lower priority targets to it.

Protection of SAC Bases

Mr. Mahon. You have been talking about protecting your SAC bases. What do you protect them with now?

General Power. My greatest protection is reaction capability, to get off the ground. That is our No. 1 reliance in the manned force. It will survive, because it will not be there to be destroyed.

Mr. Mahon. That is very interesting, but suppose you do not get off, who is there to protect you?

General Power. Of course, obviously I will welcome anybody that can protect me.

Mr. Mahon. Who do you have now?

General Power. We have the Air Defense Command, which gives as one of its top missions the protection of SAC bases, the insurance that we can get off the ground and get out. But let's face it, their defense is geared basically against the airplane threat. We are moving into the missile age. You had General Partridge in here, and I am sure you established his capability against ICBMs, which is very little.

Mr. Boyle. None.

General Power. Right. Stating it differently, as you come into the missile era, the value of point defense decreases and practically disappears.

Mr. Mahon. What about Nike? Have you Nike protection?

General Power. Nike is point defense. I say, as you come into the missile era, its value dwindles to zero as far as I am concerned.

Mr. Mahon. What is your opinion of the value of the Nike anti-aircraft defenses located near SAC bases?

General Power. Against missiles, I have a low opinion of them.

Mr. Mahon. Against airplanes?

General Power. Against airplanes it has a greater capability. It definitely has a capability, yes.

Mr. Flood. Of course, the same thing is true of the IRBM. If and when by missile era you mean ICBM, then the IRBM is of very little interest.

General Power. Russian IRBMs fired from submarines. . . .

Mr. Flood. I am talking about our IRBMs, which must be on foreign bases. If and when you get what you want, there is no need for those—except to kill them four times, maybe.

(Discussion off the record.)

Policy Meetings

Mr. Mahon. General, we have been having policy meetings. We have not talked to you about dollars. We do not think you are the best witness in that field. We hope you are conscious of the problem from the view of the taxpayer, of course.

General Power. I am extremely conscious of it.

Mr. Mahon. I have asked you to make a statement which would make questions unnecessary insofar as you reasonably could. It is not possible for 17 men to interrogate you in detail. I have undertaken to interrogate you for the benefit of the committee and for the benefit of the record. Of course, the record is not always very intelligible after all the classified material has been cut out, but I have done the best I could to ask you pertinent questions to develop information. You made an excellent opening statement. I shall not undertake to pass you around to each member of the committee, but any member of the committee who has an essential question that he wants to ask is certainly free to do so.

Mr. Sheppard. Mr. Chairman, I would like to make the following comment. This is not directly a question. You did ask for a question.

I will ask your indulgence for at least 2 minutes out of the time available.

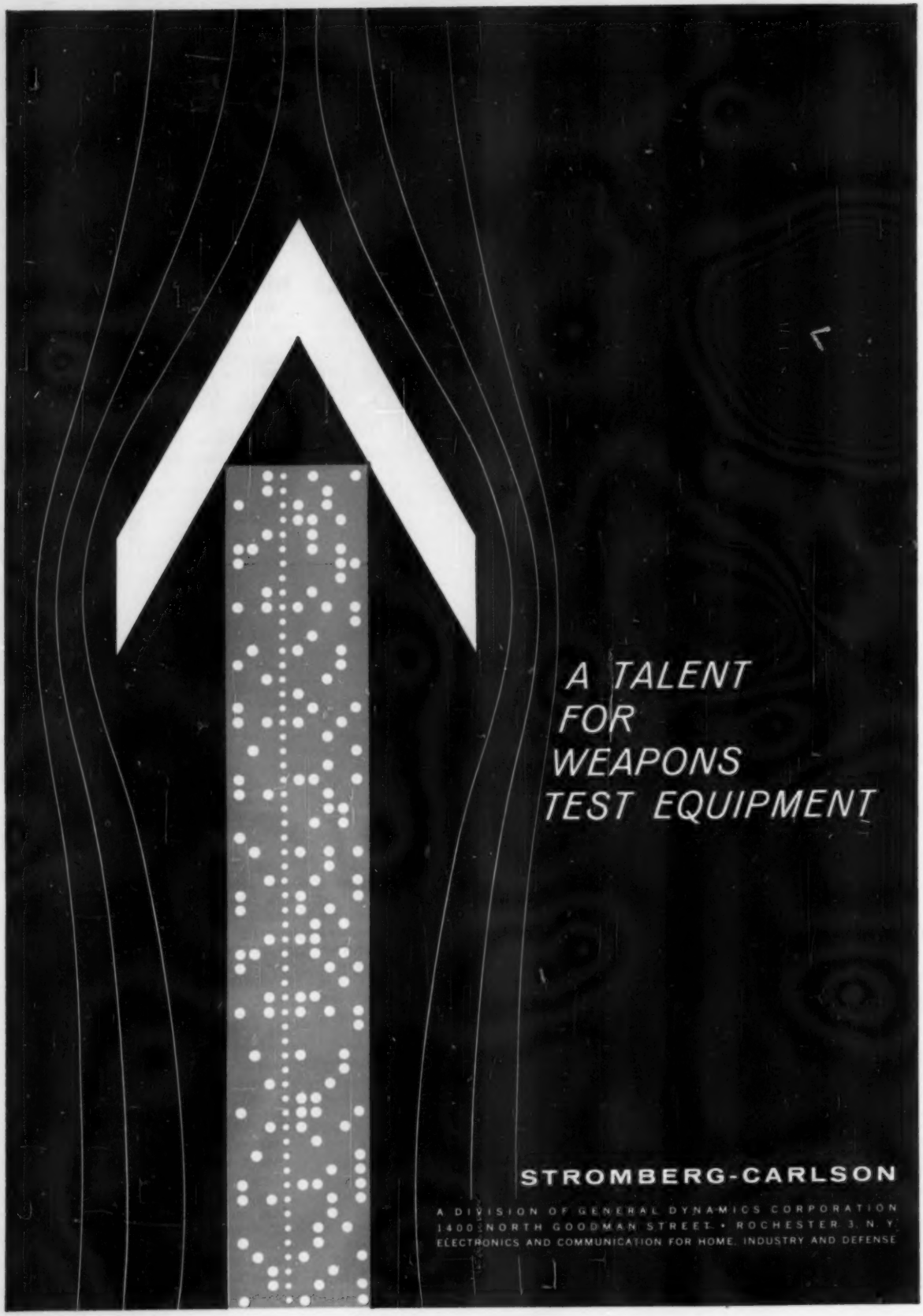
I have been privileged to sit here and listen to a lot of witnesses, and I want to express my personal compliments to you for your intestinal fortitude in stating your basic premise of evaluating the conditions with which this nation is presently confronted. I think it is extremely unfortunate that we do not have more exposé of the literal facts of life coming from what I consider top echelons who should be conveying them to the great American public.

Insofar as your requirements are concerned, your statements have been very clear and you have not withheld any responses. I want to compliment you for that very much. I have learned a lot this morning, and I appreciate it very much. Thank you very much.

Mr. Whitten. Mr. Chairman.

Mr. Mahon. Mr. Whitten.

Mr. Whitten. General, I listened to your statement, which was rather persuasive, but my reaction is that your presentation is based on the fact that until you know what Khrushchev intends or what it would take to deter him, the sky is the limit as to what deterrent power we ought to have if we can have it. It does trace back to the position that until you know what he in-


A TALENT
FOR
WEAPONS
TEST EQUIPMENT
STROMBERG-CARLSON
A DIVISION OF GENERAL DYNAMICS CORPORATION
1400 NORTH GOODMAN STREET • ROCHESTER 3, N. Y.
ELECTRONICS AND COMMUNICATION FOR HOME, INDUSTRY AND DEFENSE

Critical problems in weapons system testing: the reduction of test time with increased test reliability . . . the reduction of equipment costs with increased test flexibility.

The search for a system meeting these requirements has led to the SCATE concept of standardized block design.

SCATE—Stromberg-Carlson Automatic Test Equipment—embodies existing hardware as a nucleus.

Implementation with special stimulus generators and response monitors rounds out the SCATE system, which meets the testing needs of any weapons system, component, or sub-assembly . . .

and is flexible, self-checking, self-calibrating . . . brings lower cost, new speed and reliability to weapons testing.

Brochure available on request.

S-C GD

tends to do, you would not put any limit on anything. Of course it is impossible for us ever to know, which means you are for everything that you can get.

I, too, was in Russia shortly after you and General Twining were over there. I spent about 6 hours with Ambassador Bohlen.

My reaction from the reports of our Ambassador was that the information that our key people who were there had sent back had been blown up greatly by the time it reached this committee.

When it comes to your mission, you would agree that others in the Government, including the President and the Secretary of Defense, would have a better chance to have full information on Russia than you "yourself would in view of your other responsibilities. Would you not agree?

General Power. I have available to me the NIE, the national intelligence estimates, and I think it is the same information that they have. I do not know of any information that is withheld from me.

Impact of Defense Spending

Mr. Whitten. You were asked a question about the impact on the American economy. Having studied communism to a degree, I was surprised to find out that they do not have the Communist economic system in Russia, but they are in the control of the Communists. I am talking about their economic system which is state socialism. I am quoting our Ambassador. They are controlled by Communists, however. It may be tweedledee and tweedledum so far as that is concerned, but the fears that we find in the United States of the doctrine of communism, I think are rather groundless insofar as it does not compare with our system at all, and Russia offers it to their own only as the utopia of the future.

Since you start off that you cannot know what Russia has and you cannot know what Khrushchev has and the sky is the limit, so if there be any need to match the capability of the American economic system to stand up on a $50 billion appropriation or a $40 billion appropriation, that is a problem which faces the President as the Commander in Chief and the other officers.

General Power. That is right.

Mr. Whitten. So you would yield, would you not, to the fact that the President and the Secretary of Defense have to match your desire to have everything, since you do not know what Khrushchev has and what he wants, against the over-all needs and the over-all ability of this country to stand up under 20 or 30 years of this sort of situation. Would you agree that this is true?

General Power. There is no question about that, sir.

Mr. Whitten. This side of it is not pressed very much by many people. I had the Library of Congress give me a list of the generals and admirals who have retired and gone with the big companies who in turn are contracting with the military, and the list is great. Recently I was in a debate presumably with two private citizens. It developed that they were for more defense spending. I do not know what they wanted in the way of weapons, but that was the side they took. One of them was the editor of an aviation magazine, and the other was a retired general who is the Washington military representative of a prominent Midwest newspaper. So we see the military people getting into that field.

In addition, under the practice of this committee and the Congress, once you appropriate the money, it is mighty hard ever to cancel it.

The chairman questioned you about these various missiles. You would agree that to a great extent they overlap each other, would you not, several of them, insofar as the need that they meet?

General Power. No, I would not agree that they overlap any more than all weapon systems overlap. People have to understand that, at any particular time, we do not wave a magic wand and get a whole new force. There are always new weapons being introduced and old ones being dropped out. This is a natural condition.

Mr. Whitten. As I understood you, you were not willing to agree that any weapons system be dropped out or retarded on that their further implementation could well be delayed in view of new developments in the Atlas and other fields.

General Power. Let me make the point . . .

Mr. Boyle. I think he said Snark did not have any real utility, and he said the B-47 and the KC-97 ought to be phased out.

General Power. And the Goose.

Mr. Whitten. I have asked him the question in order for him to give the answer.

Mr. Boyle. I felt since it is on the record, it is redundant to repeat it.

General Power. I see the point you are driving at, I am sure. I would like to make the point that a lot of people get the idea that just buying weapon systems will give you military posture. You have to be very careful you do not fall in this trap, because it takes weapon systems, it takes trained men, and it takes facilities to operate them. You have to have the three. Very often the trained men and the facilities have longer lead times than the actual weapon system itself.

Earlier Statement

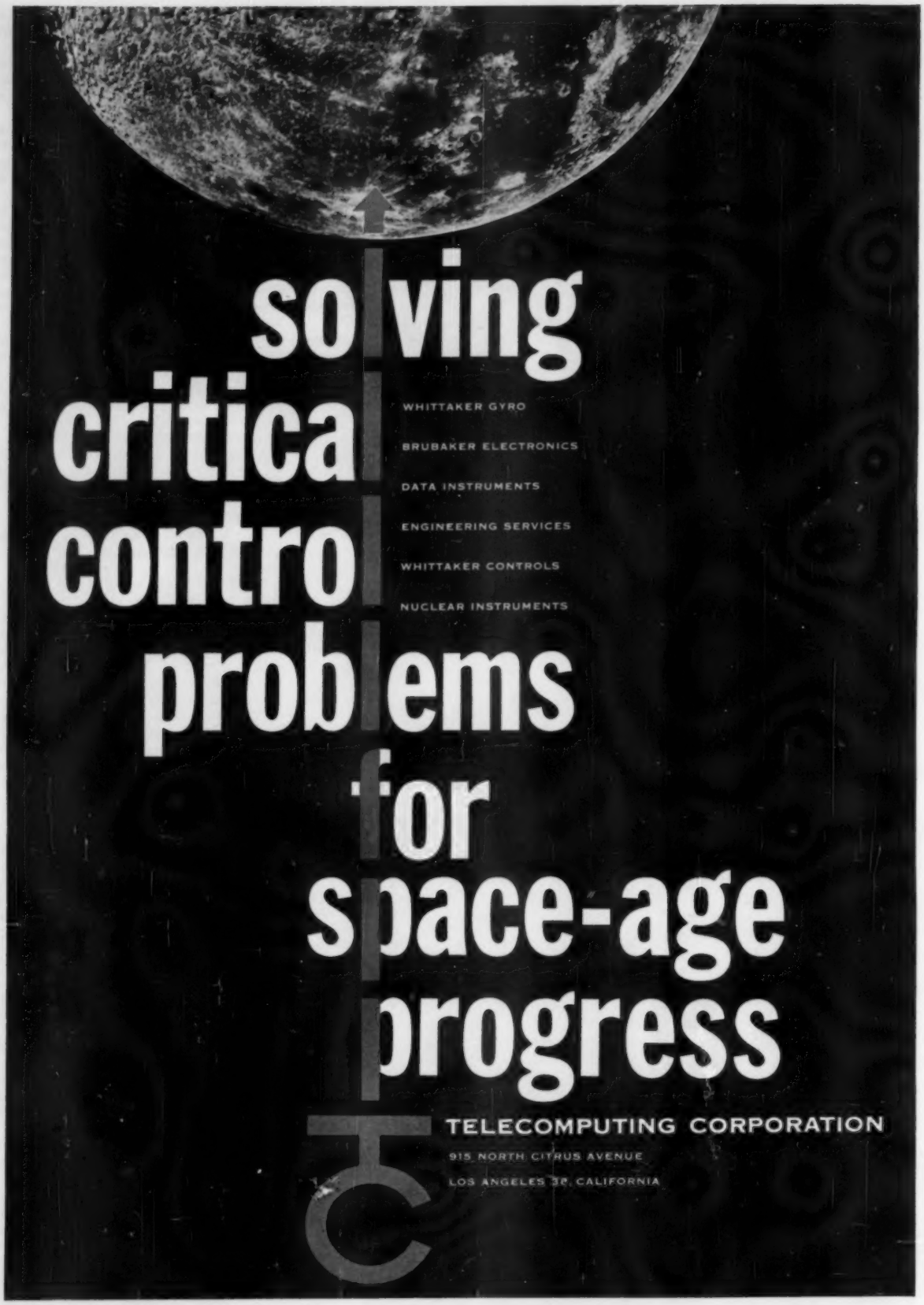
Mr. Whitten. The point I make is to develop your earlier statement that from your viewpoint nothing is too much as long as these unknown factors exist, and that therefore your attitude is that any time something new comes along you believe we should add that, too, rather than replace or cut down, say, Snark.

Mr. Taber. Mr. Chairman . . .

Mr. Whitten. I would like the witness to answer. I certainly do not mean to preclude him.

Mr. Mahon. Mr. Taber is not recognized. Proceed to answer the question.

General Power. I don't think I have made that statement. If you construe that I have asked for the moon, I haven't asked for anything. I have merely stated what I thought the requirement was. This is not based on just asking to produce all the missiles and airplanes they can, because I have to operate them. It is in accordance with a plan, timing of personnel, a knowledge of the targets, to put us in a better posture. It is not just saying "I want everything." No, I don't say that we have ever stated that. I say we have asked for more than we are now receiving, yes. The Strategic


solving
critical
control
problems
for
space-age
progress
WHITTAKER GYRO
BRUBAKER ELECTRONICS
DATA INSTRUMENTS
ENGINEERING SERVICES
WHITTAKER CONTROLS
NUCLEAR INSTRUMENTS
TELECOMPUTING CORPORATION
915 NORTH CITRUS AVENUE
LOS ANGELES 38, CALIFORNIA

Air Command has made that request. We don't get everything we ask for, but we do feel we have a deep responsibility to state what in our opinion we think we need.

Whether somebody else gets it for us or not is beside the point.

Mr. Whitten. Certainly I would agree that you do. I would also say, sitting on this side of the table, that I would figure that the President of the United States and the Secretary of Defense and this committee also have the responsibility to match what you want, to which there is no limit, against the capacity of the country to provide it.

General Power. I recognize that responsibility and hope they carry it out.

Mr. Whitten. So we are in agreement.

General Power. Right. . . .

Commendation

Mr. Whitten. I certainly wish to commend you for the persuasive way in which you presented the need for the Strategic Air Command and the ability that it has and the deterrent that it will be if used or committed.

In conclusion, in spite of your sincere and deep feelings about it, you would recognize that what you would like to have must be balanced against the needs of the various services under the over-all plan as compared with the defense of the nation.

General Power. Exactly.

Mr. Whitten. And our ability to provide it over a period of time because as it now stands it is your honest belief, is it not, that the present situation in all likelihood will last for many years?

General Power. I don't think it is going to go away. I recognize and fully appreciate my position in this over-all scheme of things. I have certain responsibilities, and I hope I am carrying them out. I recognize that other people above me have other responsibilities. All I can do. . . .

Mr. Whitten. My line of questioning was not in any way to be taken in criticism of yourself or your operation.

General Power. I understand.

Mr. Whitten. I think this side of it receives so little attention when the newspapers get advertising; with our economy tied to federal spending in munitions, when just about everybody has stock in these corporations, when just about every retired general works for such corporations, and all of that. . . .

Mr. Lipscomb. I got the impression through your statement that you were discounting the deterrent power of the Army and the Navy. I still am wondering how you get the information to evaluate the role of the carrier and the bombers thereon and the Polaris submarine.

General Power. As I said, the Polaris is not yet in operation, so just what it can do is unknown. But among the known fighting forces, we have what we call a "worldwide coordinating conference" in which SAC is pretty well charged with coordinating target systems. SAC is also responsible for operating other coordinating centers that are in contact with the war plans of the other fighting forces. So we know what they have programed and know pretty well what their capability is. We have a very good get-together. All the targets are looked at and we decide, "Can you hit it or will I hit it?" We know what they are planning to do. There is a well-coordinated effort.

Mr. Lipscomb. Yet in answer to the chairman's suggestion in regard to 1960, 1961, 1962, et cetera, you said we are becoming weaker.

General Power. I said our relative position was deteriorating. I think that is true.

Mr. Lipscomb. Even with the plans that you must know about coming into being.

General Power. Our other forces are plagued with the same problems we are, of warning and being able to operate under the possibility of zero warning. They have no magic formula to survive any more than SAC has with zero warning, with the possible exception of the Polaris which comes in in the latter part of that period and has, as far as I am concerned, up to this time, an unknown survival capability. We are very much interested in this in SAC. What is the survivability of the submarine? A lot of very good thought is being put into this. It is an unknown quantity and you cannot apply an exact mathematical equation to it. I hope I have painted the picture of how we do work together in these worldwide coordinating conferences on all targets. For example, we met out in Omaha with represenatives of all the theaters. We went over all the target lists, everything that SAC is planning to do, everything they can do, how and when this might have to do it, and tried to make a common plan out of this. This is what gives us a pretty good feel of the over-all capability today. But the future is always an unknown and can only be estimated.

Mr. Lipscomb. Yet each branch of the service keeps building up its shopping list instead of concentrating in one area or another.

General Power. This is the responsibility of the Joint Chiefs of Staff. All the services come in with their requirements, and the Secretary of Defense has to decide just how much will go into the various pockets. This is a really difficult task.

Mr. Lipscomb. General, I get a clear picture from your testimony in regard to SAC's mission, but at this point in our committee hearings I am not so clear as to the over-all missions of the other branches of the service and I hope to before we conclude they will be somewhat clearer. . . .

Mr. Minshall. How heavily does SAC rely on the ability of the carrier task force to survive the opening phase of nuclear war and to deliver an effective quantity of nuclear weapons to Russian targets?

General Power. As I said before, we have worldwide coordinating conferences. We coordinate all of our capabilities and all of our targeting philosophies as we sit down together and work this thing out. We try not to be in competition with one another. You do not get anything extra by being the one who bombs something. There is nobody who is bucking for this. There is no extra prize you get or a few extra Brownie points. We try to do it in the most efficient way we can.

Whoever has an assured capability and

New (Model 734) Heavy Duty

CUSHMAN®
ELECTRIC TRUCKSTER

Now you can carry up to a half-ton payload plus operator and passenger in a safe, silent, efficient Cushman Electric Truckster — gain extra convenience and economy.

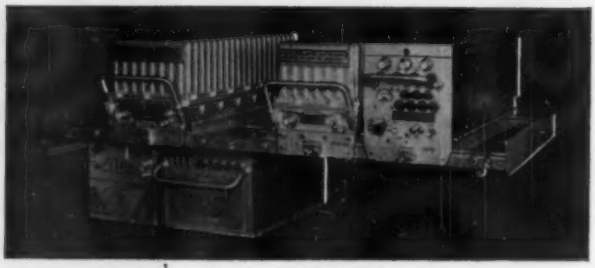
Rigid unitized construction . . . heavy duty rear suspension . . . wedge type drive belts . . . a big 45⅝" by 61½" flat bed that can be equipped with stake racks . . . all add up to a rugged workhorse. Powered with heavy duty batteries, the 734 Electric Truckster travels up to 50 miles without recharging for a minimum operating cost. Fiber glass cab is available as optional equipment.

Ask your dealer for a FREE demonstration or write for illustrated literature

Sold and serviced nationally — replacement parts immediately available
Dealer inquiries invited

CUSHMAN MOTORS
A Subsidiary of Outboard Marine Corporation
Lincoln, Nebraska

CUSHMAN MOTORS
1062 No. 21st, Lincoln, Nebraska
Please send complete information on the 734 Truckster
NAME_____
ADDRESS_____
CITY_____ STATE_____



ABOARD
THE
AIR FORCE'S
F-105

COLLINS ELECTRONICS

In Republic's F-105 Thunderchief Fighter-Bomber, USAF's Tactical Air Command has a potent and versatile new aircraft — capable of striking at supersonic speeds with a variety of nuclear and conventional weapons.

Providing the vital functions of communication, navigation and radar identification in advanced models of the F-105 is the AN/ASQ-37 integrated electronics subsystem in which Collins played the major development and systems engineering role.

Brought from concept to production in less than a year and a half, this outstanding example of Weapons System electronics cut space requirements in half, providing up-to-the-minute performance and reliability.

COLLINS RADIO COMPANY • CEDAR RAPIDS, IOWA • DALLAS, TEXAS • BURBANK, CALIFORNIA

can get there first—we let them go there first.

Again, I have a responsibility for the lives of my crews. We will have to fight our way in. We will fight our way in with hydrogen bombs. This will not be an easy job.

I will not put one of my crews in and tell them to penetrate unless I know the defenses have been attacked.

If I believe that another force, which claims it will blow up this thing, cannot do it, due to its limited all weather or night capability, then, in a condition such as this, I will probably put my own airplanes in there to take care of that, because I have a deep responsibility for the lives of my crews.

However, wherever I think this can be done by a Navy airplane or a theater airplane, I will gladly give it to him. I have more than enough work to do.

Mr. Minshall. If the bell should ring tomorrow morning we have the capability of delivering a substantial nuclear attack on the potential enemy, and we have had testimony before this committee from General Taylor and others in the ground forces, and others in the Navy who say we have more than enough to completely obliterate the enemy should they attack tomorrow morning, even though they made the initial attack. Do you agree with that?

General Power. I say General Taylor has a lot more confidence of our over-all ability than I do under the condition where they attack us.

If I get no warning of this attack, I have zero capability right at this minute, that is, provided they have the capability to destroy my forces on the ground. You have to first tell me how much warning I am getting of this attack. This is the thing that changes everything.

Mr. Minshall. If we were attacked tomorrow morning how much warning do you think you would get?

General Power. I think I would get ample warning if they are using only airplanes. I think we could make them real sorry.

Mr. Minshall. That is what I am talking about, tomorrow morning.

General Power. If you mean actually tomorrow.

Mr. Minshall. Yes.

General Power. There is no question about it.

Mr. Minshall. How about a year from tomorrow morning?

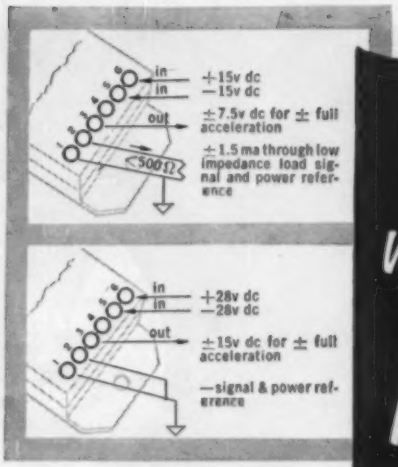
General Power. I believe we developed this at some length before.

Mr. Minshall. This follows in with this question.

General Power. As I said before, and I think there is a lot of testimony on the record, it basically depends on getting missiles in quantity and the possibility that we will not have an adequate warning system or forces tailored to operate with zero warning.

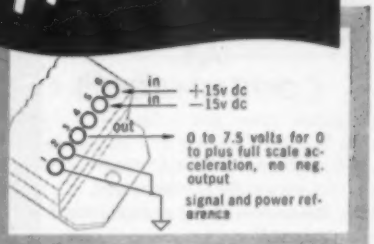
Mr. Minshall. You seem to minimize the effectiveness of our Nike systems especially against missiles. You did not give it too high a capability in attacks against enemy aircraft. How does our Nike system compare with that of the Russians and specifically with their air defenses around Moscow?

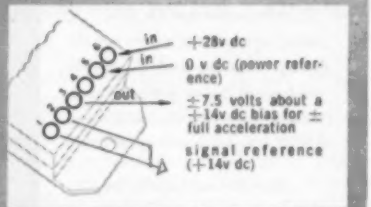
General Power. They have a surface-to-

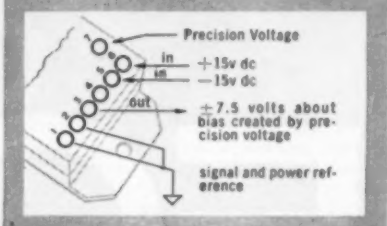


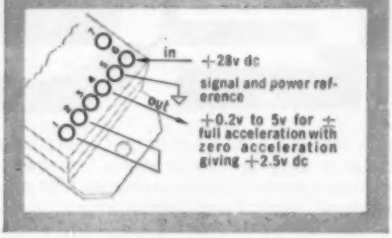
6 ways to solve CONTROL PROBLEMS with DONNER ACCELEROMETERS

Donner 4300 series 0.1% transistorized force balance accelerometers can be connected in a number of ways to solve various control and measurement problems. Typical operational hookups for applications in telemetering, servo stabilization, gyro erection, acceleration switching, and short range inertial guidance are shown.









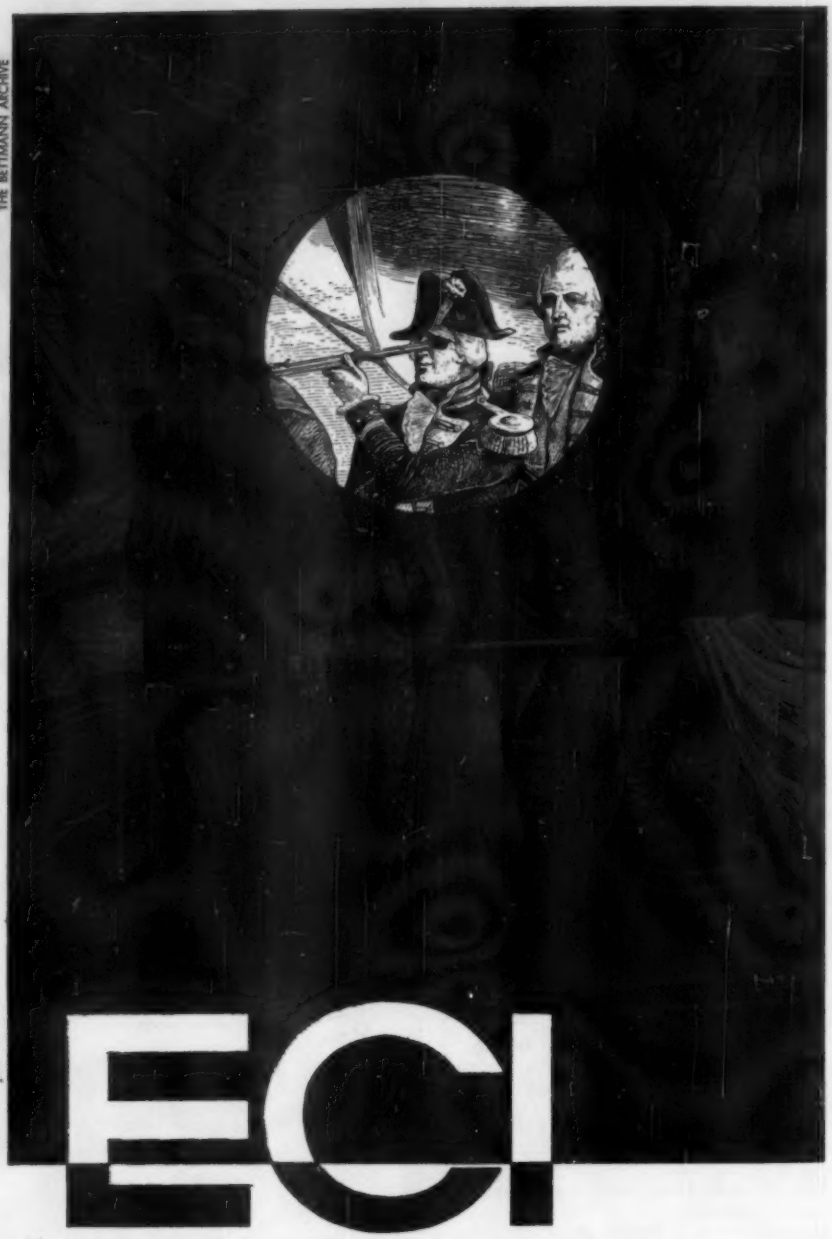
Model 4310 high output, high resolution accelerometer. Key specifications: non-linearity plus hysteresis, within 0.05% deviation from best fitted straight line; standard ranges, between ±0.05g full range and ±30g full range; resolution, better than 0.0002% full scale; weight, 3.5 ounces; standard output, ±7½v dc and/or ±1.5 ma full scale; options, biased output, fluid-filled units, and/or 28v dc operation; price, $450. f.o.b. Concord, California, options extra.

Split case version of the Model 4310 for use in limited space applications; electronics on right, sensing unit on left.

Donner engineering representatives are located in principal cities. For complete technical information, call your nearby representative or write directly to Dept. O54

DONNER SCIENTIFIC COMPANY
CONCORD, CALIFORNIA
Phone MUlberry 2-6161 • Cable "DONNER"

14



THE BETTMANN ARCHIVE

RECALL AT COPENHAGEN

During the battle of Copenhagen, April 2, 1801, Sir Hyde Parker, Commander-in-Chief of the English fleet, whose ship, the London, *was stationed some distance from the fight, peering with mounting anxiety into the flashing, thundering clouds of gun-smoke, and believing that the battle was going badly for the English, hoisted the RECALL signal to break off the action.*

Rear-Admiral Lord Nelson, on the badly-damaged Elephant, *in the thick of the action, felt sure of the victory that ultimately was achieved.*

In great indignation at the order, Nelson turned to his flag captain and said, "Why to leave off the action! Now damn me if I do! You know, Foley, I have only one eye. I have a right to be blind sometimes."

He raised his long-glass to his blind eye, smiled at the bunting fluttering over the London, *and announced, "I really do not see the signal."*

ECI

Blind command in this age of quick-reaction military operations might not turn out so happily. Instantaneous two-way command and data link Electronic Communication is essential for effective control of strategic, tactical and defense forces.

ECI is proud to be supplying major communications equipment to our Armed Forces in surface, air borne and space applications. Systems such as the air borne communication and data units linking the latest USAF all-weather Century Series Interceptors into the Continental Defense network are ECI products.

One of a series of advertisements depicting historic incidents in military communications through the ages.

E C I

...ONIC ...UNICATIONS ...c. St. Petersburg, Florida

Specialists in advanced electronic communications, countermeasures and detection systems.

Regional Offices: Washington, D.C., North Hollywood, Calif., Paramus, N.J., Dayton, Ohio, Dallas, Texas

air missile system. I have much more knowledge of our own Nike system, Nike-Hercules system, than that of the Russians. I have to penetrate the Russian systems. I think I can penetrate them.

Mr. Minshall. How effective do you think of our Nike-Ajax and Hercules respectively are against enemy air attack?

General Power. Airplanes?

Mr. Minshall. Yes, bombers.

General Power. I think they will be effective to a degree. Point defense has always a limited value.

(Discussion off the record.)

Mr. Minshall—That is all I have, Mr. Chairman.

Mr. Mahon. General Power, your appearance before the committee has been most helpful.

I have one final question. There are, as you know, funds in the 1960 budget for the procurement of Strategic Air Command weapons, including airplanes and missiles.

If you had your way exclusively, and I am asking now for your personal opinion, would you change the allocation of these funds in any significant way?

General Power. This is the 1960 budget.

Mr. Mahon. Yes, the one before us.

General Power. Merely talking about relationship between airplanes and missiles?

Mr. Mahon. Yes, but I am talking about using SAC dollars. Can they be used to better advantage?

General Power. Referring just to weapons systems?

Mr. Mahon. Or any related matter. All I want is a frank statement of your own personal views.

General Power. This is a difficult thing to answer. Really, in my opinion—and you have to take this in context with other things—you will buy more military posture through good personnel actions today, particularly in SAC, than in any other area.

As I said before, the pay bill has been of tremendous help. The life one leads as an alert crew member is an inconvenient life at best, plus about an 80- or 100-hour week.

I would like to have alert pay for these crews. It is psychological rather than a matter of getting rich. It should be $10 for every 24 hours a man is on alert.

The ground alert air crew is on an 80-hour week alert.

I think the motivation you get from this is tantamount to somebody recognizing that what you are doing is a pretty inconvenient way to live. You sleep in your clothes. You have the same clothes on day and night.

Alert pay would require a small amount of money. Spot promotions for my crews are also important.

We have spot promotions in SAC, but we got them years ago when we had only 750 crews. We have tripled and quadrupled the number of crews but have the same number of spot promotions, and we are even losing these.

Again, this represents a very small sum of money. The first item I mentioned, "Alert pay for SAC," is somewhere in the neighborhood of $15 million. My spot promotions would run to about $5 million.

Mr. Mahon. A year?

General Power. Yes.

These are things that would buy me tremendous mileage. Machines do not fight wars—men fight wars. You get tremendous motivation out of these things.

Housing is another tremendously important thing. This is all meant to stabilize our force. Over 50 per cent of the airmen in SAC have been in the command for less than 2 years. We have fantastically complex equipment. We have $11 billion invested in the hardware at SAC.

I have mentioned some personnel actions that I would certainly firm up first.

There are other things. You must take care of your operation and maintenance money. We have this tremendous plant, representing an investment of $11 billion. We have to keep it up. We have to fill up the cracks in the runways, keep the roofs from leaking. I want the right amount for that and have it in proportion to the overall costs.

We need spare parts and support equipment. Ground support equipment is not glamorous, but you cannot start an airplane without it and you cannot run a missile site without it.

When you start saying you have to do it in the proper proportion, these are areas where I would like more. They are not way out of whack, but I would like to put them in a little better proportion.

Of course, a lot depends on warning and airborne alert. This airborne alert is something that will be costly, mostly in sweat and in the hours our men will have to put in.

We will have to increase and almost double or triple our flying hours, so our fuel costs will go up.

Mr. Mahon. You have commented on one aspect of this problem.

Now as to the other aspect, as to procurement of hardware, by way of planes, missiles and so forth. . . .

General Power. I will give a priority. No. 1 priority in SAC—and I am talking about the immediate future and taking full consideration of time—in buying this country military posture of deterrent value, is the KC-135-B-52G combination with the Hound Dog missile. That is No. 1 priority.

Mr. Mahon. Would you like to take some of the dollars in procurement in this budget if you had exclusive authority to make a personal decision here and apply more of it to that and less to something else?

General Power. I have to know what I will get first. It is in a state of flux. Once I know, I would have to make a hard decision that I would rather have this than that.

As it faces me now, I would like to have more 52s and KC-135s, compressed in time. In the objective program, USAF has shown me the . . . wings of 52s but they are stretched out too far. I want them faster. That would increase the price, and then we would have to drop something else out.

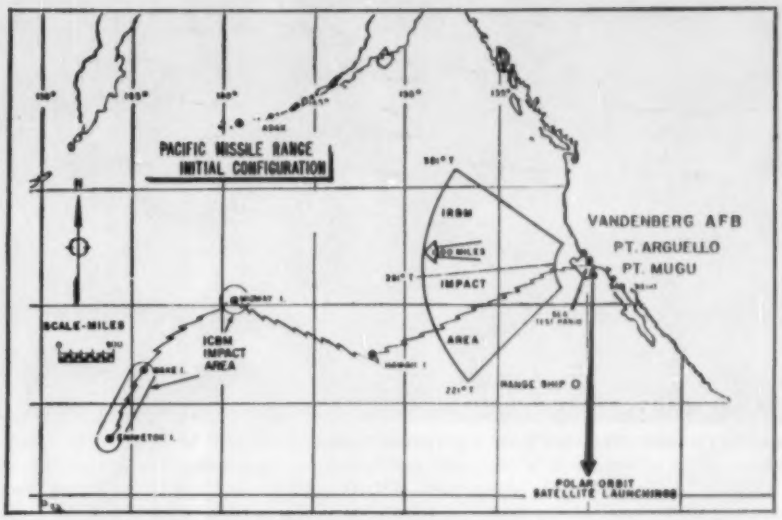
Mr. Mahon. What would you drop out?

General Power. Again, the missile probably will carry a major share of this role in the future; so time forces this decision. You cannot ignore the future, so you need both.

Mr. Mahon. Would you say that probably, insofar as you know, the procurement dollars are fairly well balanced?

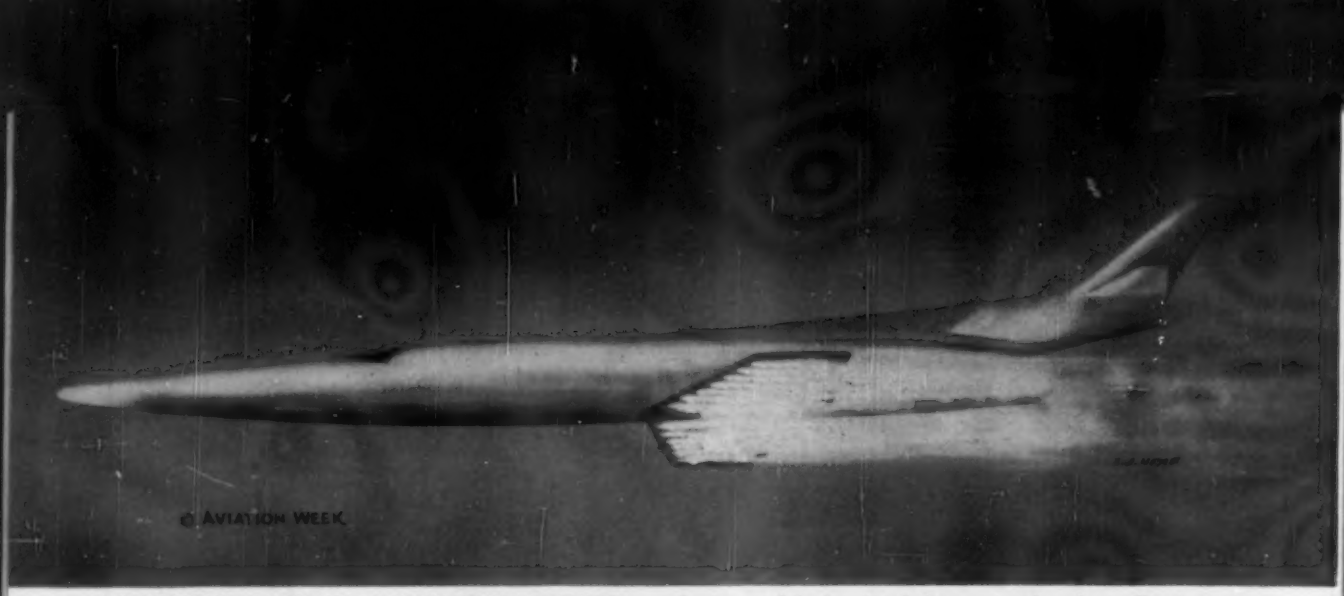
General Power. Within the amount being allocated to SAC I would say, yes.

Mr. Mahon. Thank you very much, General. You have been very helpful to us. . . .



Pacific Missile Range Configuration

Pacific Missile Range provides services for all projects launching long range missiles and satellites from the West Coast. The range also operates the old sea test range and inland range of Naval Missile Test Center, Pt. Mugu. Pacific Missile Range comprises Pt. Mugu, Naval Missile Facility Pt. Arguello, installations at San Nicolas Island 50 mi. offshore, and at Midway, Wake and Eniwetok. Range ship is USNS Private Joe E. Mann. A second range ship is being requested in Fiscal 1960 and long range planning calls for 12 range ships to serve the missile ranges and satellite projects being fired from Vandenberg AFB and Pt. Arguello (AW Mar. 16, p. 86).



AERODYNAMIC EFFICIENCY OF HYPERSONIC AIRCRAFT may be increased by burning fuel on external surfaces. Burning pattern shown above covering most of the under surface of the wing is designed to increase lift. Drag may be decreased and thrust possibly produced by burning fuel on the aftersections. Aircraft may be cooled by burning fuel on the complete outer surface.

Efficiency of External Burning Studied

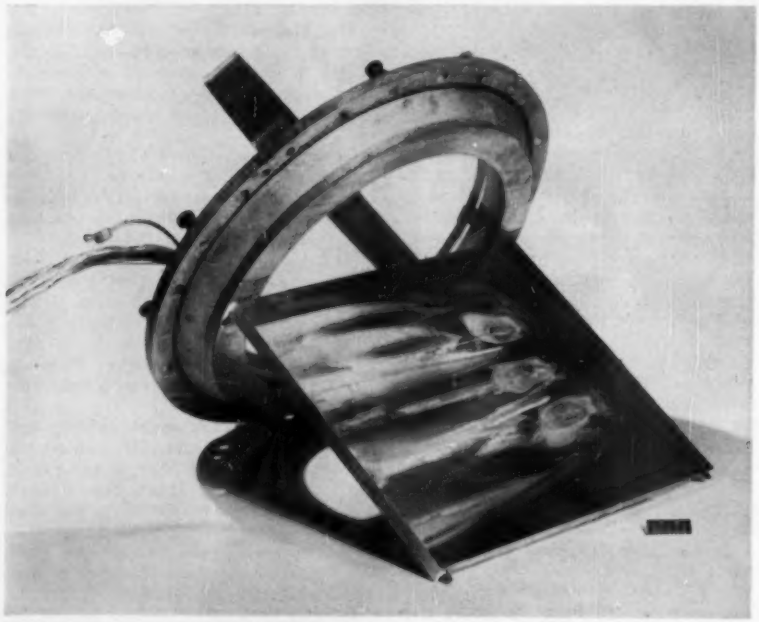
By J. S. Butz, Jr.

Washington—Steady burning of fuel along the external surfaces of hypersonic vehicles may be used to decrease drag, increase lift, replace conventional air-breathing engines and cool the entire vehicle.

Wind tunnel tests performed by the National Aeronautics and Space Administration have shown that highly reactive fuels such as aluminum borohydride will burn continuously and stably on the outside of an aircraft at supersonic speeds. No flame holders are needed. The external surface of the aircraft and its low energy boundary layer air will support stable combustion.

NASA tests designed primarily to increase lift have shown that the lift/drag ratio of a wing may be doubled at Mach 2.5 and 3 by increasing the static pressure which occurs when heat is added to the flow under the wing by burning fuel in that area.

Other tests in this same Mach number range indicate that it is possible to completely eliminate the drag of cylindrical bodies by burning fuel near their base. The drag of wings also may be eliminated by ejecting and burning fuel near the trailing edge. Small amounts of thrust have been produced in this manner.



TYPICAL RIG used by NASA in tests with external burning of highly reactive fuel such as aluminum borohydride is shown above. Two dimensional wing was used in experiments which showed that lift/drag ratio could be doubled at supersonic Mach numbers. Burning pattern behind fuel ejection holes is visible.

Major Question

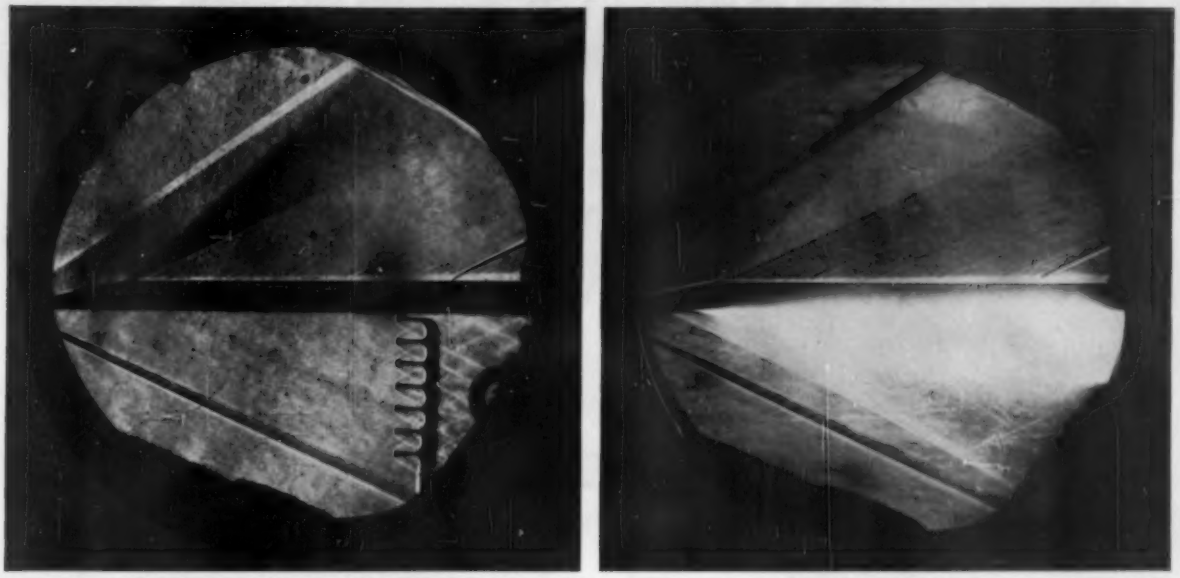
Major technical question at present is whether this type of fuel expenditure is more efficient than burning fuel in a conventional airbreathing engine. Test data and theoretical information available show that at the speeds used in present tests, external burning is not as efficient as employing a conventional ramjet for producing thrust or lift, but that at Mach numbers above 6 or 7 this situation probably will be reversed. However, the information now on hand is not conclusive enough to have generated a unanimous opinion among the scientists working on the problem.

NASA is continuing its exploratory research into the question in order to provide the wider foundation of knowledge which will have to precede any large, systematic developmental research effort needed to produce information necessary for design of useful vehicles.

The basic question that will have to be answered by demonstration is whether combustion can be maintained at the speeds and altitudes of interest in hypersonic flight. The present incomplete theory indicates that it will be possible.

Needed Answers

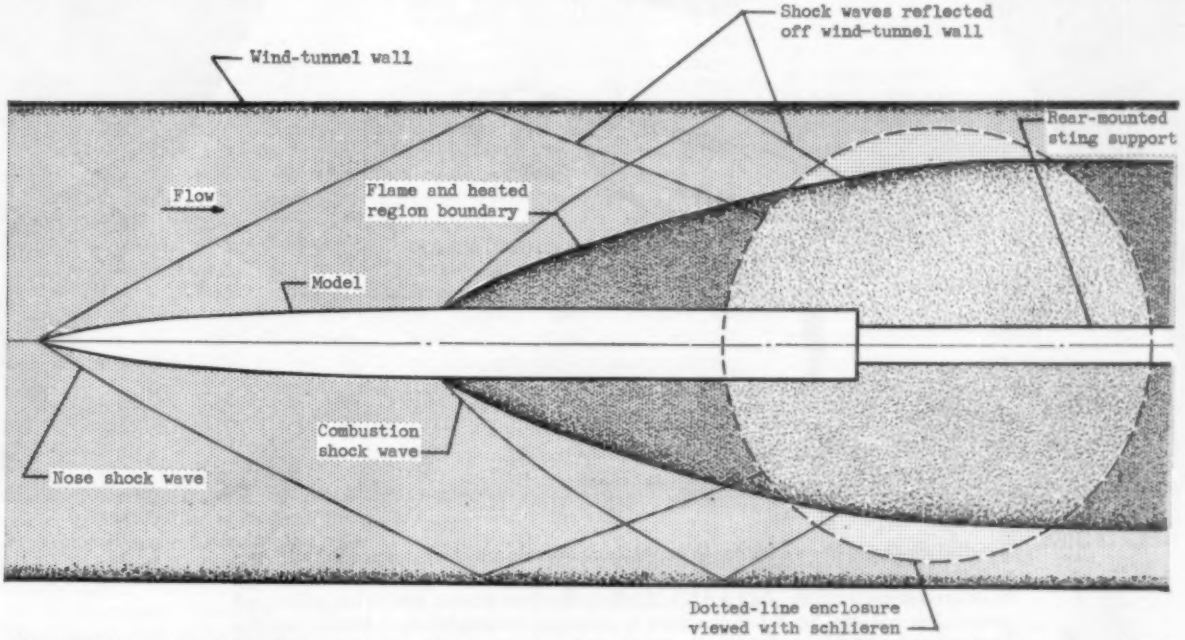
Once this has been established, it will be possible to more conclusively work on several pertinent problems and to begin to determine whether they can be solved more efficiently through external burning or by some other means. These problems are:



SCHLIEREN PHOTO AT LEFT SHOWS TWO DIMENSIONAL WING in tunnel. Instrumentation includes total pressure rake shown below wing, static pressure orifices in the wing surface and temperature and static pressure rakes. Burning pattern of fuel is shown at right in combination schlieren and open shutter photo. Flame is held with weak shock system behind strong leading edge shock. Weak shock is created by fuel as it is ejected under pressure from the lower surface.

• **Cooling an orbital vehicle** re-entering the atmosphere or a hypersonic aircraft in steady flight by burning fuel over its hottest areas so that their temperature will be brought down to approximately the combustion temperature of the fuel. This might prove more efficient than using a heavy heat sink structure or carrying a cooling system.

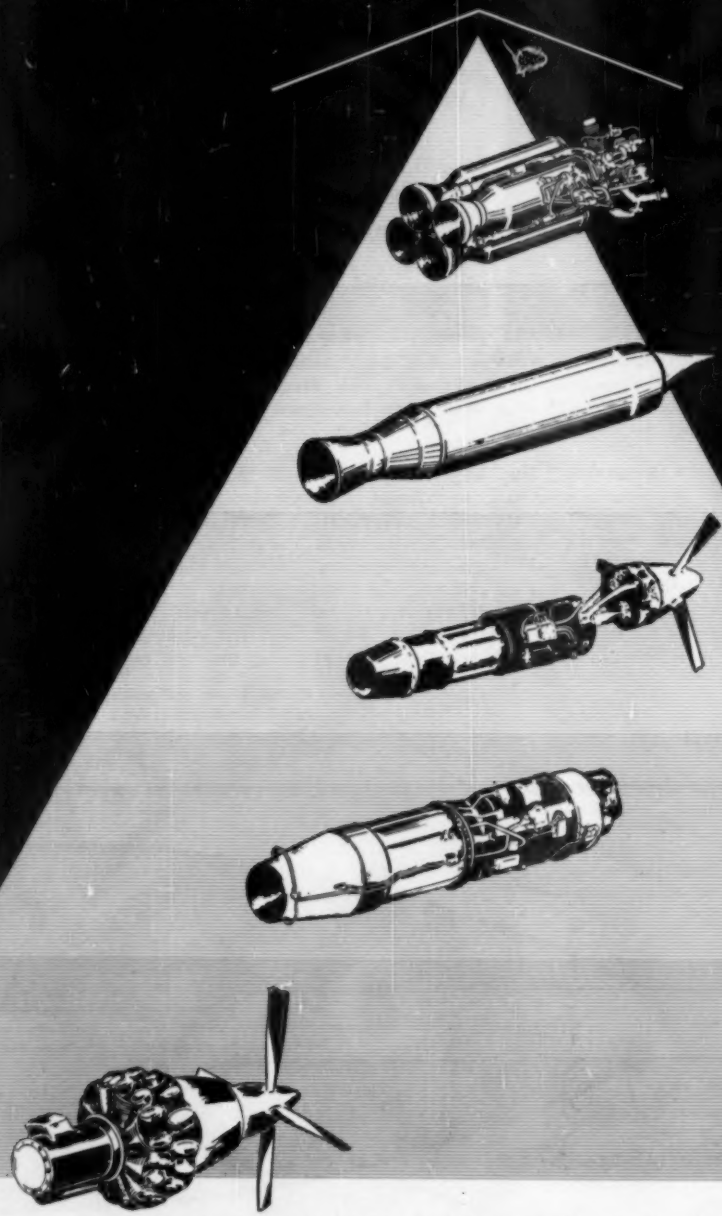
• **Overcoming the high temperature** problem of conventional internal burning ramjet engines which apparently will limit their usefulness to somewhere in the Mach 4-6 range. The temperature of the ram air entering the combustion section of these engines will be in the neighborhood of 3,000F, which is above the useful temperature of most of the materials which could be used today to construct such a ramjet. Therefore, cooling probably would be required. Burning fuel in such a combustion chamber would raise the temperature to around 5,000F. The high temperature in the engine could be greatly reduced if it was not enclosed and the heat could be radiated to the



COMBUSTION AND ASSOCIATED FLOW around a body of revolution is drawn as it occurred during NASA wind tunnel tests. Shock waves reflected from the tunnel walls have been shown to have little effect on the combustion zone.

CONTROLS

FOR THE FULL SPECTRUM OF PROPULSION SYSTEMS



Bendix* has long been a leader in supplying controls and fuel systems for all types of aircraft engines. Today, Bendix is proving to be a natural for new challenges in related missile fields—on ram jets, rockets, nuclear power, and other advanced propulsion systems. So, when it comes to controls, remember that Bendix has the background—and is anxious to share it in solving your problems. *REG. U.S. PAT. OFF.

BENDIX PRODUCTS DIVISION **SOUTH BEND, IND.**

Bendix AVIATION CORPORATION

surrounding atmosphere. If external burning is practical, then it may be possible to cool a ramjet by effectively turning it inside out and designing some geometrical arrangement into the external surface of an aircraft which will be an efficient thrust producer if fuel is burned on it or in it. This may even be possible on a clean wing.

• **Improving the lift/drag ratio** of hypersonic vehicles by either increasing lift through burning fuel under the wing or by eliminating drag by burning fuel on the aftersections. If the optmistic opinion held by some researchers proves correct, then this will be economically possible on a continuous basis, substantially increasing the range of a vehicle. If some less hopeful opinion is valid, this would be efficient only for intermittent use to, as an example, give a vehicle a high effective lift/drag ratio while it is flying at zero angle of attack. This might prove useful during the few minutes of very high aerodynamic heating a vehicle will experience in returning to earth from an orbit. Heating of the vehicle can be kept down somewhat if the angle of attack remains low and a high effective lift/drag ratio can be maintained to reduce the rate of descent into dense air.

Research Approach

Two interrelated and supporting methods will be used to find the answers to these efficiency questions. Basic research and theoretical study will be used to improve the understanding of the processes taking place as the air flow about a vehicle and the burning fuel mix. This will form the basis of more empirical investigations on configurations which more closely approximate useful vehicles.

Information about other systems and ideas which will be competing with external burning as a solution to very high speed flight problems also is fairly sketchy at present and will require more investigation before valid efficiency comparisons can be made of various hypersonic vehicle proposals.

One avenue of work has been opened by experiments with external burning in supersonic flow which go back several years. This provides the possibility of maintaining supersonic rather than subsonic flow in the combustion chamber of a conventional ramjet. A number of engine people feel that this type of design could create more problems than it would eliminate but that it may prove possible in the future to reduce the heating and pressure losses in the engine by not slowing the air down to subsonic speeds.

Work on external burning at NASA is being conducted by a group under Irving Pinkel at the Lewis Research Center in Cleveland. Latest published

Eliminates Instrument Interference!

• Just as we expected, many aircraft designers were interested in the recent announcement of our new non-magnetic aircraft cable. If you did not see it, "NO-MAG" has these characteristics:

NON-MAGNETIC PROPERTIES . . . "NO-MAG" cable is made from type 305 stainless steel. It remains non-magnetic after severe cold working —in contrast to standard stainless steel aircraft cable which shows a pronounced increase in magnetism after swaging, wire drawing or similar operations.

This non-magnetic property of "NO-MAG" cable eliminates instrument interference from cable magnetism.

CORROSION RESISTANCE . . . New "NO-MAG" cables have corrosion-resistant qualities similar to, but slightly better than, cables made of standard stainless steel.

GOOD THERMAL CHARACTERISTICS... The thermal expansion characteristics of new "NO-MAG" cable are much closer than those of standard stainless steel or carbon steel cables to the characteristics of aluminum alloys used in aircraft. This greatly simplifies maintaining cable tension under various changes in temperature.

HIGH FATIGUE RESISTANCE . . . Preformed construction and careful processing give new "NO-MAG" cable high fatigue resistance.

HIGH ABRASION RESISTANCE . . . New "NO-MAG" cable shows greater abrasion resistance than standard stainless steel aircraft cables.

TENSILE STRENGTH, while lower than that of stainless and carbon steel, is sufficient to enable replacing these, size for size, with "NO-MAG" on many applications where the characteristics of "NO-MAG" are required.

USE WITH SWAGED TERMINALS . . . Swaged terminals can be applied to standard AN dimensions.

COMPLETE RANGE OF SIZES, CONSTRUCTIONS . . . New "NO-MAG" is furnished in sizes from 1/16" to 1" in all of the standard aircraft cable constructions.

Get the complete story on this new technical development for the aircraft industry. Write today to Detroit office.

Automotive and Aircraft Division
AMERICAN CHAIN & CABLE

ACCO

601 Stephenson Bldg., Detroit 2
6800 East Acco Street, Los Angeles 22 • Bridgeport 2, Conn.

NASA report in this area is Memo 1-11-59E entitled "Experimental Investigation of Aerodynamic Effects of External Combustion in Airstream Below Two-Dimensional Supersonic Wing at Mach 2.5 and 3.0." The report was prepared by Robert Dorsch, John Serafini, Edward Fletcher and Pinkel.

Work also has been conducted in this field by the Navy, Johns Hopkins University and some private companies.

Latest Report

The NASA report is the latest on the work performed on wings. The work was designed primarily to produce a lift increase by ejecting the fuel at about 100 psi. gage pressure from three orifices located at about the 27% chord on the under surface of a two dimensional, 6% thick blunt-base supersonic wing. The highly reactive aluminum borohydride fuel was ignited by a spark from a rod placed in close proximity to the under surface of the wing. After ignition, the rod was folded against the tunnel wall and the combustion was self-supporting and stable, lasting two to three seconds before the fuel supply was exhausted from ejector system.

The measured lift/drag ratio of the wing used in this test was almost doubled while the fuel burned. The exact mechanism by which this increase in performance was produced is not yet known. The NASA report says: "Because there has been little experimental work to date on combustion in supersonic streams, little is known about the details of the combustion zone. The location of the heat addition region below the wing is therefore not known with certainty. The schlieren and direct photographic observations are not sufficient in this respect because, although they show the geometry of the flame and the heated flow, they do not directly give information on the location or intensity of the combustion (or heat addition) region itself.

"The flame-shock structure and the chordwise pressure profile caused by the heat addition are most useful in defining the heat-addition region. They suggest that strong combustion took place in the upstream portion of the flame (within one or two inches of the fuel orifices) followed by a rapidly decreasing rate of combustion with distance downstream. In addition, visual observations of the flame far downstream of the base indicated that part of the fuel may be burned in the wake rather than below the wing."

Other statements in the NASA report indicate the possible future of external burning as envisioned by the people working on the project at Lewis Research Center:

"A comparison with internal burning ramjet engines indicates that external burning requires considerably higher total fuel consumption rates at the low supersonic Mach numbers of this test. However, theoretical considerations indicate a steadily decreasing over-all efficiency for the conventional ducted ramjet engine (with subsonic combustion) at Mach numbers between 5 and 10, whereas the over-all efficiency of external burning remains relatively constant in this speed range. It therefore appears that external burning will be competitive at higher Mach numbers.

"It is recognized that an internal combustion ramjet engine using supersonic combustion may combine some of the advantages of both types of engines.

"This engine should therefore also be considered as a future possibility when assessing the relative merits of various airbreathing propulsion schemes for use at hypersonic Mach numbers."

PRODUCTION BRIEFING

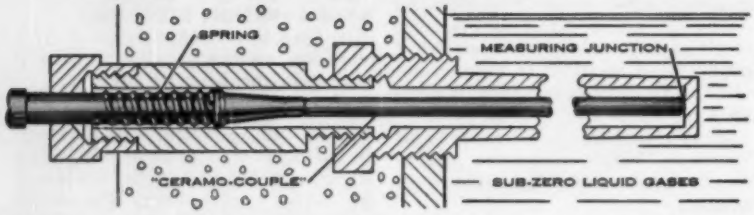
Royal Industries, Inc., Los Angeles, Calif., will produce Boeing B-52 stabilizer drive mechanisms under $445,000 contract and elevator devices for the Northrop Snark launching system, under $155,000 contract. Work, contracted from Boeing and ACF Industries, will be undertaken at Vard, Inc., a subsidiary of Royal.

Scottish Aviation, Ltd., will install Industrial Acoustics Co.'s Duro-Stack steel test cells at Renfrew, Scotland. Test cell, incorporating two separate flow paths in a single cylindrical shell, permits testing of two engines on an Avro CF-100 aircraft either singly or simultaneously.

Ryan Aeronautical Co., San Diego, Calif., will build liquid rocket motors, exhaust manifolds and other high temperature components under contracts totaling $3 million. Contracts are from Air Force, Firestone Tire and Rubber Co., and General Electric Co. Components to be built by Ryan under the new contracts include rocket motors for the Firestone Corporal rocket, General Electric J79 jet engine cones and exhaust systems for the Douglas C-124.

Federal Aviation Agency has issued its first aircraft engine type certificate to Lycoming Division of Avco Manufacturing Corp. for a four-cylinder helicopter powerplant designated VO-360-A1A which is rated at 180 hp. at 2,900 rpm. Horizontal model No. 0-360-C2B was certificated at the same time for commercial helicopter use. The VO-360 will power the Brantly B-2 helicopter ordered by Army under designation YHO-3.

Sub-Zero Ceramo-Couple Solves Condensation Problems



"Ceramo" versatility has also solved a key problem of *sub-zero temperature measurement*—condensation. Caused by wide temperature differences between ambient temperatures and the thermocouple measuring point, condensation can penetrate thermocouple insulation and short out conductors.

Overall Metal Sheathing of "Ceramo" thermocouple wire completely encloses conductors and ceramic insulation—shutting out moisture effectively. Sheathing itself is stainless steel or other corrosion-resistant material.

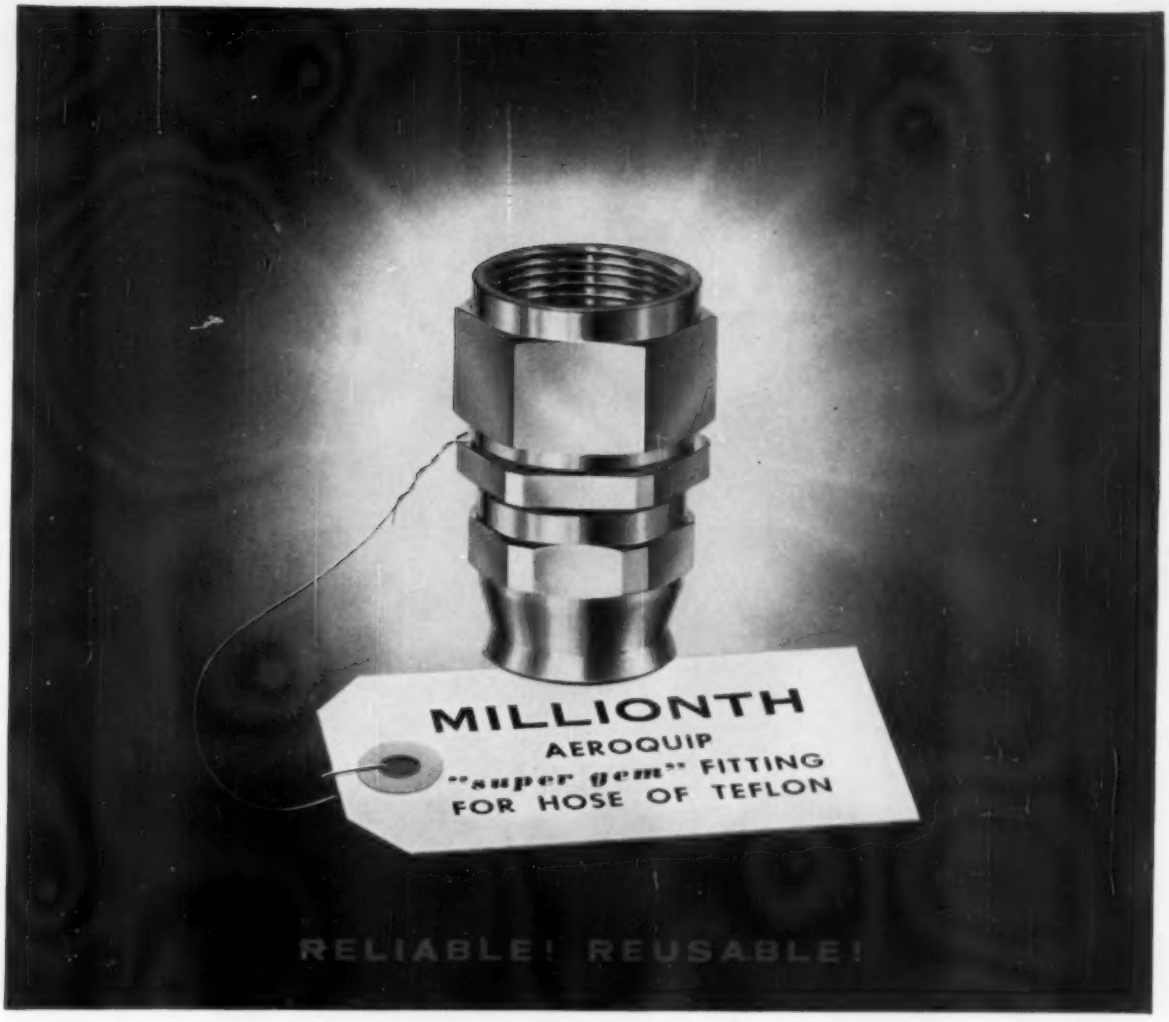
Spring-Loaded Construction of T-E's sub-zero probe holds contact point firmly against thermowell end—counteracting effects of expansion and contraction from temperature changes.

Applications—Liquid oxygen, nitrogen, ammonia and similar applications. Conductors are either Copper-Constantan or Chromel-Constantan for measuring temperatures as low as —320° F.

Write For Bulletin 52-

Thermo Electric CO., INC.
SADDLE BROOK, NEW JERSEY

In Canada:
THERMO ELECTRIC (Canada) LTD.,
Brampton, Ont.



Over one million Aeroquip Reusable ***"super gem"*** Fittings* for Hose of Teflon are now in use. This wide acceptance proves the reliability and dependability of the ***"super gem"*** Fitting.

This wide acceptance proves, too, the value of the Aeroquip Reusable Fitting idea which assures time saving, money saving advantages throughout the aircraft/missile industry.

Get the full story on these important advantages by sending the coupon for the short, graphically illustrated booklet listed below.

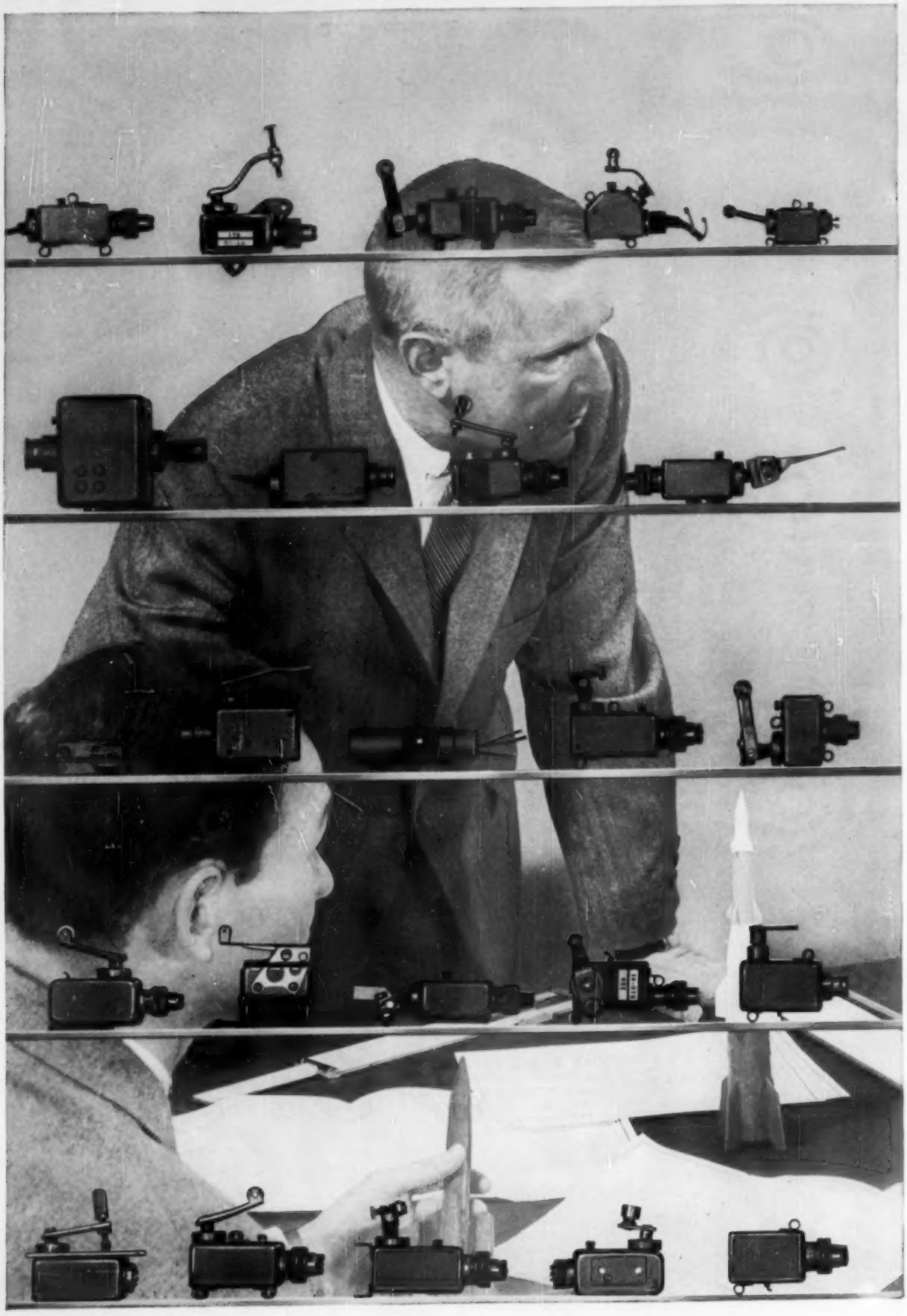
Aeroquip

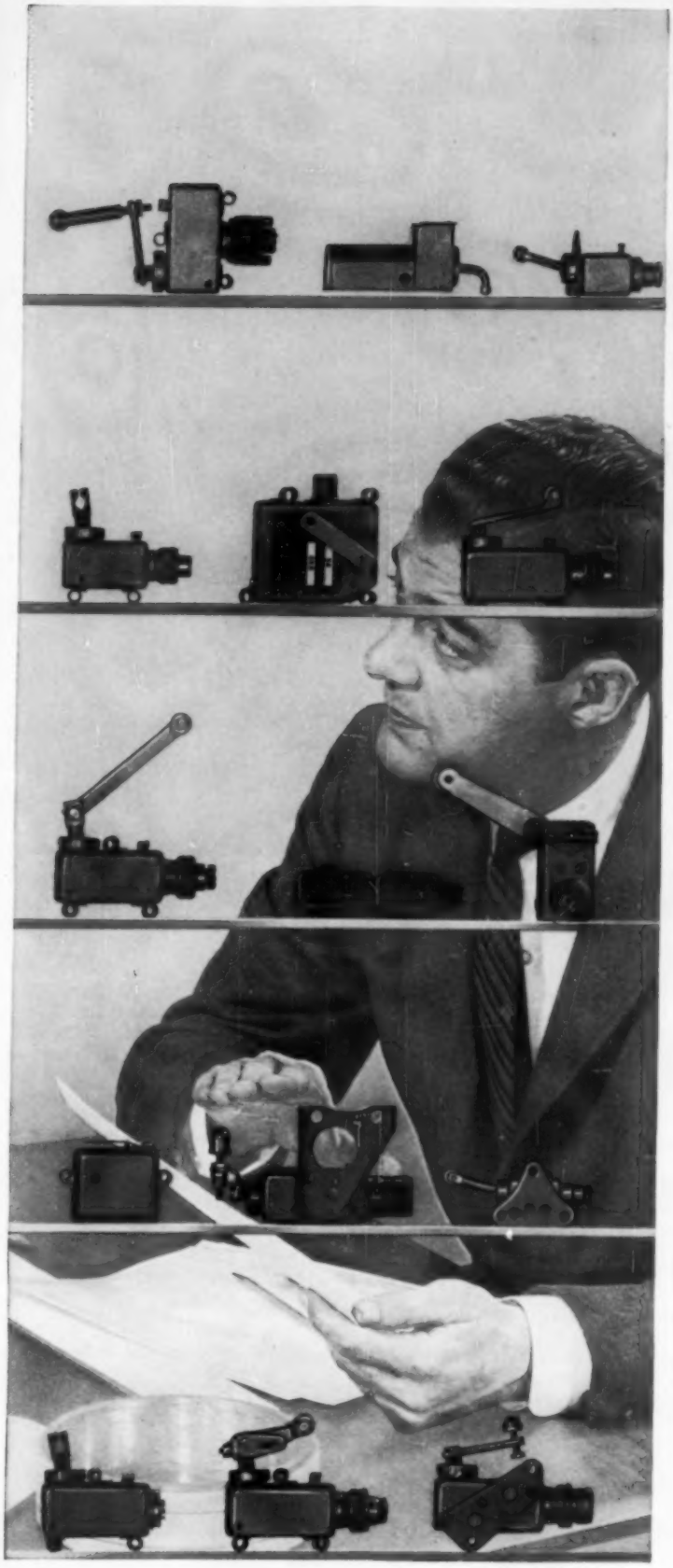
AEROQUIP CORPORATION, JACKSON, MICHIGAN
AEROQUIP CORPORATION, WESTERN DIVISION, BURBANK, CALIFORNIA
AEROQUIP (CANADA) LTD., TORONTO 19, ONTARIO

Teflon is DuPont's trade name for its tetrafluoroethylene resin
"super gem" is an Aeroquip trademark. *U.S. Patent Nos. 2,833,567 and 2,731,279

AEROQUIP CORPORATION, JACKSON, MICHIGAN
Send me the complete ***"super gem"*** Fitting Story in your NEW Bulletin 241.

Name_____ Title_____
Company_____
Address_____
City_____ Zone_____ State_____





in LOX cold or blast-off flame

These special hermetic and environment-free switches were designed to perform perfectly in unusually rugged environments. For example...

An Electrosnap valve position indicator switch for a liquid fuel rocket works reliably on valves handling LOX at minus 300° F.

A major missile uses a specially-designed Electrosnap switch as an interlock or "away" switch, to prevent the missile from being fired when it is not within specified aiming limits. This switch must function within range of the rocket flame.

Absolutely reliable long storage life is a feature of an Electrosnap mass acceleration switch used to cut-in the guidance system on one of our stockpiled missiles.

One of the successful IRBM's has an Electrosnap separation switch which signals for firing Stage Two when Stage One is dropped.

Behind these, and many other hermetic and environment-free switches, are many design conferences where leading missile and aircraft manufacturers developed unusual requirements for switches and controls. And they took their problems to Electrosnap for solution.

As a result, whatever your requirements, we probably already have a standard design that can fill your need. The savings in time and money are yours. If a special switch or actuator is required, we can quickly create or modify a design in any quantity to your specifications. Send us your problem.

Write for complete technical literature on Hermetically-Sealed and Environment-Free Switches.

ELECTRO SNAP

ELECTROSNAP CORPORATION
SWITCH DIVISION
4232 West Lake Street
Chicago 24, Illinois
Telephone VAn Buren 6-3100 • TWX CG-1400

suit-ability

FROM PHILOSOPHY — TO FEASIBILITY STUDY — TO DESIGN AND PRODUCTION

GENERAL ELECTRIC'S GROUND-BASED GUIDANCE SYSTEM FOR THE ATLAS MISSILE REQUIRED A COMPLETE MAINTENANCE TRAINING METHOD FOR MILITARY PERSONNEL WHO WOULD BE ENTRUSTED WITH THE UPKEEP OF THIS MODERN WEAPON.

ERCO WAS SELECTED FOR THIS CRITICAL TASK.

ERCO TRAINING . . . TO FILL THE SUITS . . . TO SERVICE THE WEAPON

The requirements imposed by this intricate electronic problem were satisfied through unusually close engineering liaison, with appreciable economy and compressed schedules.

ERCO

NUCLEAR PRODUCTS — ERCO, DIVISION OF
ACF INDUSTRIES, INC., RIVERDALE, MARYLAND

AMERICAN CAR AND FOUNDRY • AVION • CARTER CARBURETOR • SHIPPERS CAR LINE • W-K-M

CONVAIR 540 is powered by two Napier 504A Eland 6 turboprop engines which generate a cruise speed of 322 mph. at 20,000 ft.

Aviation Week Pilot Report:

Turboprops Boost Convair's Capabilities

By Robert I. Stanfield

New York—Canadair 540—which is a blend of the Convair 440 airframe and two Napier 504A Eland 6 turboprop engines—should be a rugged and well-suited addition to local service operations. The mixture has produced a speed in excess of 300 mph., a 2,000-fpm.-plus rate of climb, and good single-engine and short-field capabilities, a flight evaluation by AVIATION WEEK showed.

The pressurized and air-conditioned aircraft, aimed at the short-to-medium haul airline, military uses, and the executive market, also will be available in combination cargo-passenger and all-cargo configurations.

Production of the 540 will be handled by Canadair, Ltd., subsidiary of General Dynamics Corp., at its Montreal plant. The company bought the production jigs and tooling for the basic 440 airframe from the Convair Division of General Dynamics (AW Mar. 30, p. 44). Canadair also will convert piston-driven Convair 340s and 440s to Eland power.

Cost of the 540 is $1.4 million delivered, including a 12.5% import duty. This embraces all equipment, interior furnishings and communications, and includes the standard 48-passenger or high-density 58-passenger transport versions. Conversions of existing Convair 340s and 440s in Montreal will cost $515,000, including the 12.5% import duty. Canadair also makes available a kit which, with import duty, costs $490,000.

The Eland 6 engines, including all auxiliaries and equipment, cost $125,000 each. The turboprop utilizes a single-spool, 10-stage axial flow compressor with six tubular combustion chambers, and a three-stage power turbine. Gear ratio is .0912:1. Fuel is JP-1 or JP-4.

Maximum powerplant diameter is 36 in. Length is 9 ft. 11¼ in. Net dry weight, less tailpipe, is 1,820 lb. Overall frontal area, including accessories, is 7.1 sq. ft. The de Havilland hydromatic, full-feathering, four-bladed propellers—of 13 ft. 6 in. diameter—weigh 1,760 lb. each, with equipment. Pitch range runs from full-feathering (84.5 deg.) to disking (3.5 deg.).

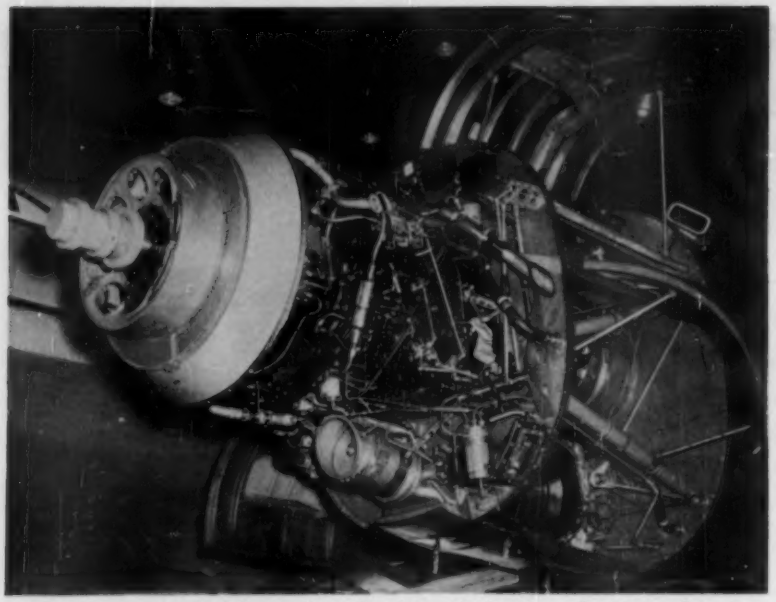
Turboprop engines together generate 7,000 ehp. at 12,500 rpm. at takeoff, an increase of 40% over the Pratt & Whitney R2800-CB-17 piston engines that power the 440 Metropolitan. Takeoff field length (CAR) of the 540—4,550 ft.—is better than 8% less than that of the Metropolitan, while its takeoff weight (maximum is 53,200 lb.) is 4,100 lb. more than the 440.

Cruise speed of the 540, at 20,000 ft., is specified as 322 mph. (280 kt.), compared with best cruise speed of 289 mph. (251 kt.) for the Metropolitan. The 540 takes about 6.4 min. to climb to 10,000 ft., as against 14 min. for the piston-driven version.

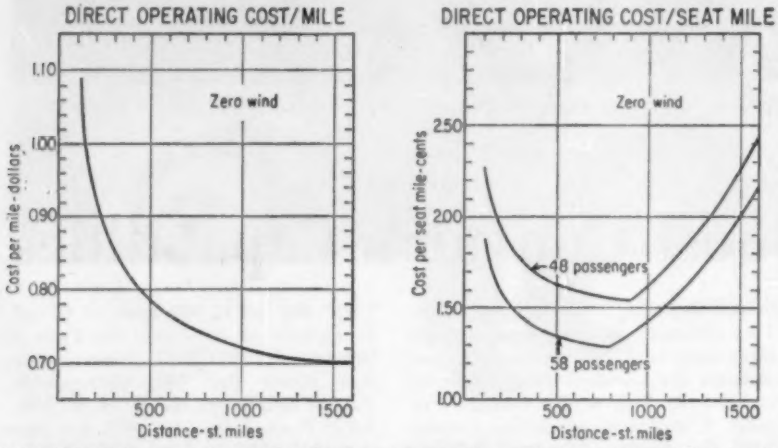
Features evidenced during AVIATION WEEK evaluation included:

• **Acceleration and climb.** Grossing about 48,000 lb., the 540 built up speed rapidly with application of takeoff power. Airplane was airborne at 120 kt. after a roll of about 1,700 ft. into a 10 kt. wind. Rate of climb hit the 2,000-fpm. peg and was estimated initially to be about 2,500 fpm. Specifications call for the 540 to reach 20,000 ft. in 15.6 min.

• **Single-engine performance.** Left engine was feathered at 10,000 ft. Right



ELAND 6 is composed of four replaceable self-contained units: reduction gearbox, compressor and main support plate, combustion system and three-stage reaction turbine.



TURBOPROP transport is geared to local service operations. Block speed for 200 stat. mi. is now computed at 251 mph.; direct operating cost, per hr., at $195.33.

engine was set to takeoff power—12,500 rpm. Gear and 15 deg. of flaps were dropped. At 120 kt. indicated, with four degrees of rudder trim, aircraft climbed at 300 fpm. In this configuration the 540 was pulled into a stall, following buffet at 95 kt. indicated. Lateral control was good; there was no tendency to fall off on wing and recovery was made with negligible loss of altitude.

• **Short-field capability.** Landing field length (CAR) for the 540 is 4,020 ft. Airplane was held to 110 kt. on approach, 101 kt. over the fence, and touched down at about 84 kt. With propellers retarded to ground fine pitch, the 540 easily could have turned off at the 2,000 ft. intersection to the 6,550 ft. runway.

The preproduction demonstrator flown by AVIATION WEEK at Westchester County Airport retained the 440 interior configuration of 44 seats. The basic Convair airframe structure is all-metal. Wing spars, bulkheads, truss members and upper and lower wing surfaces are 75ST aluminum alloy. Fuselage is 24ST and 75ST aluminum alloy. Wing structure is full cantilever box type, incorporating two spars. Fuselage is semi-monocoque construction incorporating transverse frames and longitudinal stiffeners.

Service door, hinging forward, is 30 in. wide by 65 in. high, located on left, rear side of airplane. Front and rear cargo compartment doors, 36.5 in. by 48 in., and 30 in. by 48 in., respectively, are located on right side of airplane. Both are hinged at the top.

The belly cargo compartment door, outward-opening and downward-swinging, is located on the forward lower right side of the aircraft. The door is 38 in. wide by 36 in. high. Its inner surface is covered with a glass fiber liner.

Five emergency exits, 19 in. wide by 26 in. high, each incorporating a standard window, are installed in the passenger compartment. Removable-type exits open inwardly.

The complete fuselage is pressure-sealed with the exception of the nose-wheel well. Fuel is carried in two integral tanks outboard of the engine nacelles. Usable fuel capacity has been increased to 2,032 gal. by moving the tank bulkheads outboard.

Passenger door on the 540, 36 in. wide by 83 in. high, is just ahead of the left powerplant. Entrance is via an integral stairway, operated hydraulically by power derived from landing gear down pressure lines.

The cabin is pressurized to maintain a maximum differential of 4.16 psi.—8,000 ft. cabin altitude for 20,000 ft. flight altitude. Pressure is obtained from a variable speed compressor installed in the right-hand nacelle. The compressor is automatically uncoupled in event of failure of opposite engine.

Individual ventilation outlets, for air conditioning, are above each seat. Heating is by means of a heat exchanger which has as a heat source ram air conducted over engine tailpipes. Cooling is by means of an air expansion turbine and a secondary heat exchanger. An independent blower is installed for ground cooling. All controls are electronic.

Control Units

Dual wheel and pedal-type flight control units are installed for pilots. Mechanical trim controls are located on center pedestal. Both rudder and aileron are trimmed by knobs on top and at aft end, respectively, of the pedestal. The elevator is trimmed by a wheel for each pilot on either side of the pedestal.

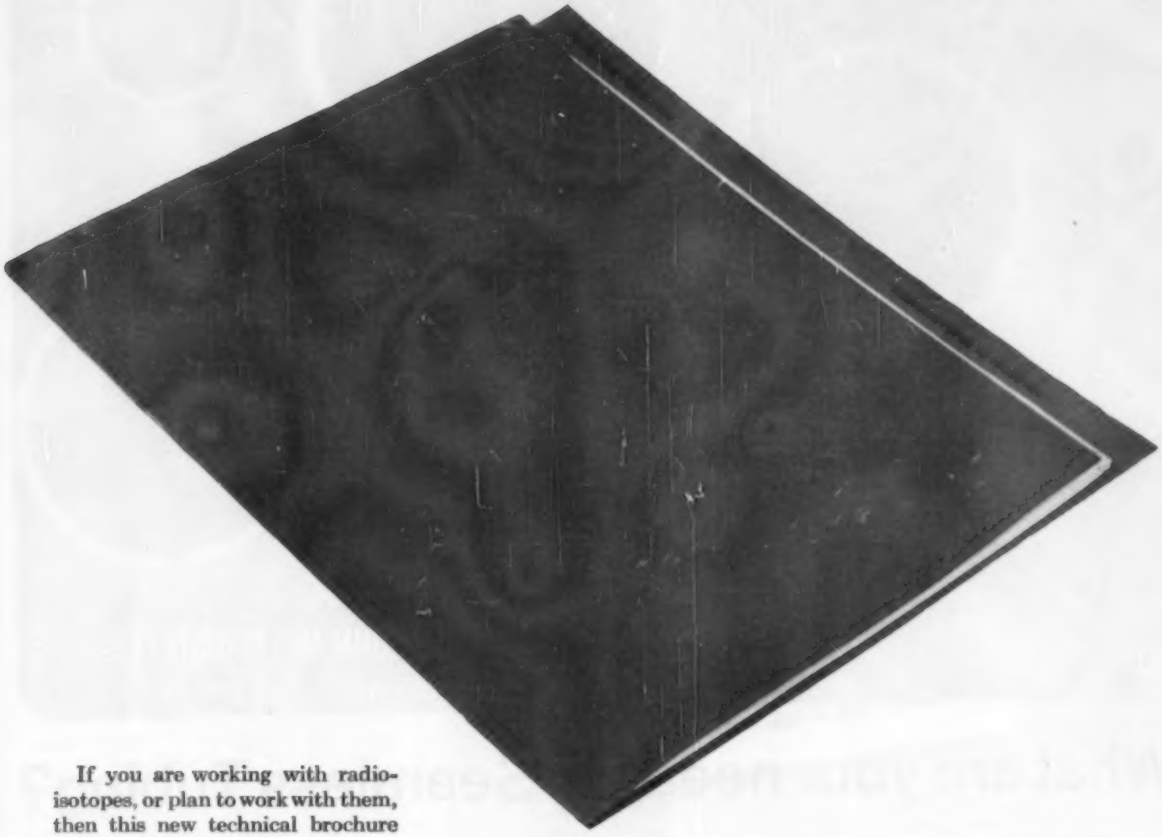
The windshield is of impact-resistant laminated plate glass, replaceable from outside the airplane. Electric heat is provided for anti-icing. It can withstand the impact of a 4 lb. bird at cruise speed. A clear-view panel, which opens inward, is installed at the outboard end of each side of the windshield.

Controlled red and white illumination is provided for the three instrument panels. Navigation equipment includes two ADF receivers, two VHF receivers for omnirange and localizer, a marker beacon receiver and glide slope receiver. Flight instruments are mounted on the pilot's and copilot's panels. Engine instruments are centered, forward of pedestal. Radio

COBALT 60, CESIUM 137, IRIDIUM 192 . . .

the whole story in a nutshell in Ansco's free new

"RADIOISOTOPES IN INDUSTRY"



If you are working with radioisotopes, or plan to work with them, then this new technical brochure is a must for your files.

It gives needed facts and figures on the use of major radioisotopes . . . explains in detail half-lifes, intensity, energy . . . and, describes how each of these characteristics affect exposure time and radiographic quality. It also presents basic exposure factors and compares the quality of radiographs made by exposure to x-rays and gamma rays.

SEND FOR YOUR FREE COPY NOW!

Ansco

Industrial X-ray

Ansco, Binghamton, New York
Industrial X-ray Dept.

Gentlemen: Please send me a copy of "Radioisotopes In Industry". I am actively engaged in industrial X-ray work.

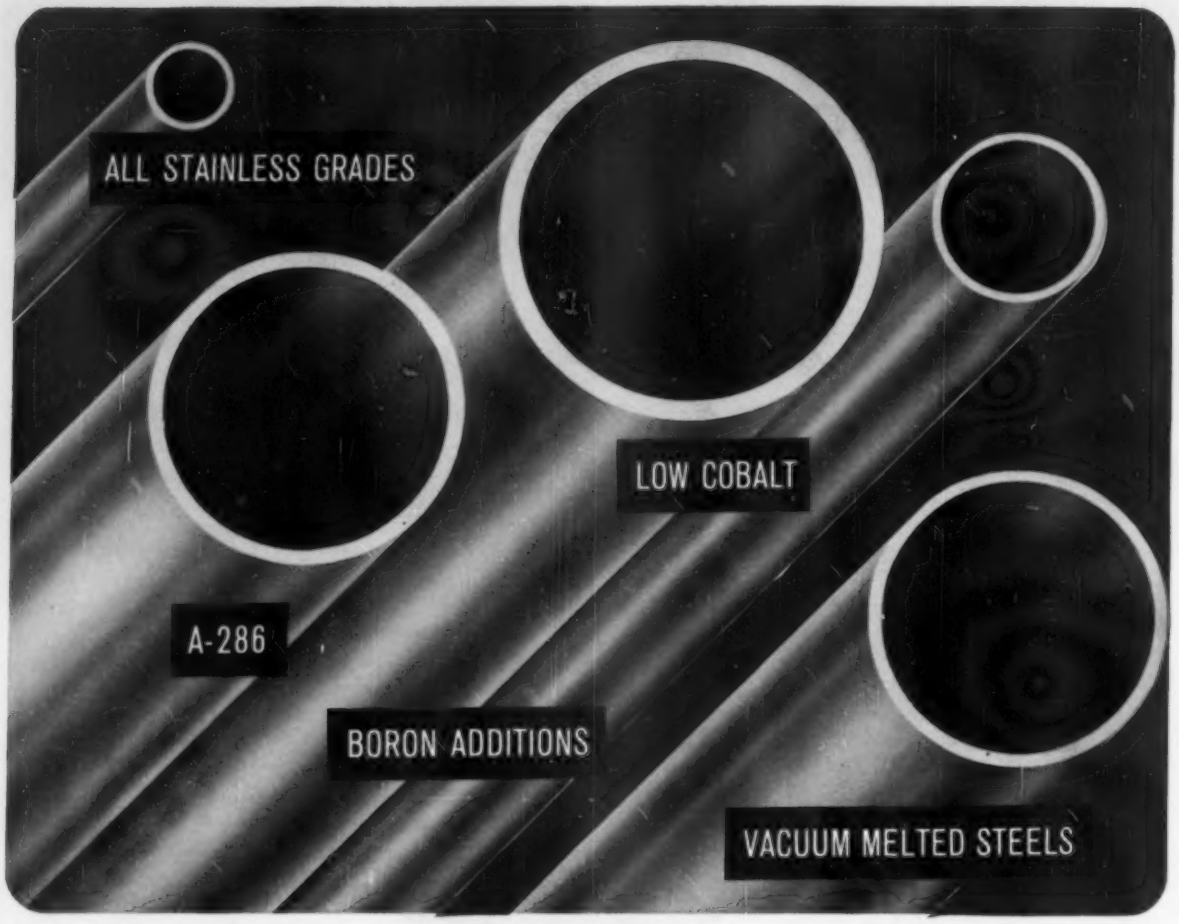
Name _____

Position _____

Firm _____

Address _____

Experience *— the added alloy in* ***Allegheny Stainless***



What are your needs in Seamless Tubing?

A-L offers widest range of materials and large diameters with walls as thin as .032".

Here is the widest range in materials in stainless seamless tubing available anywhere to meet your exact requirements and solve high-temperature or corrosion problems and save you money.

Allegheny Ludlum makes seamless tubing in all stainless grades including 309, 317, 318, 310, 416 and 446—normally difficult to obtain. Also available in high-strength alloys such as A-286, in vacuum melted steels, and in custom analyses grades such as low cobalt with .01 or .05 max. and small boron additions to standard types.

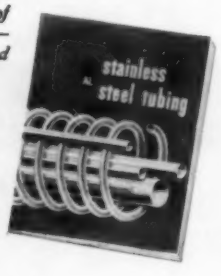
A-L also makes composite tubes with bonded combinations of carbon and stainless and other metals for special chlorine-corrosion applications in process equipment.

Allegheny Ludlum Stainless Tubing ranges from 3/16" OD to 3½" OD with wall thickness ranging from .013" to .375"—typical of the sizes that A-L can produce. For certain applications, .500" walls are possible. Some standard sizes in stock are 2½" OD—.032" walls, 3" OD—.042" walls and 3½" OD—.042" walls and 3½" OD—.058" walls. All sizes with true circularity, no dents or handling marks.

A-L Tubing is also available in small quantity orders, in random or cut lengths. Standard grades and sizes in stock throughout the country. Call your nearest A-L representative for all the help you need.

Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa. Address Dept. AW-16.

NEW! FREE—Write for your copy of Allegheny Ludlum Stainless Tubing—32-pages of technical data, grades and suggested applications.



WEW 7829

ALLEGHENY LUDLUM

for warehouse delivery of Allegheny Stainless, call RYERSON

Export distribution: AIRCO INTERNATIONAL

EVERY FORM OF STAINLESS . . . EVERY HELP IN USING IT

Canadair 540 Cost

(Using the ATA 1955 method, modified to reflect current operational practice and costs.)

	U. S.
Aircraft "initial" cost	$1,249,000
plus 12½% import duty	156,125
Utilization, hours per year	3,000
Flight operations:	
Crew cost[1]	$36.10/hr.
Fuel & oil cost:	
(Fuel at 12.5 cts./U. S. G.)	
(Oil at $7.00/U. S. Gal.)	49.70
Insurance 3%	14.05
Maintenance:	
Airframe & materials	6.71
Labor	12.12
Engine materials	24.00
Labor	6.00
Depreciation: (10 years to 15% residual)	
Airframe & spares	35.94
Engines & spares	10.71
Total direct operating cost, $/hr.	195.33
Block time for 200 stat. mi., hr.[2]	0.796
Block speed for 200 stat. mi., mph	251
D.O.C., ct./seat mile,	
48 passengers	1.62
58 passengers	1.34

Note:

[1]Crew cost is based on total of 11 min. maneuver time.

[2]Block time is defined as "off/on" time plus 6 min. air maneuver time.

controls are provided on pedestal and side consoles.

The aircraft flown was N440EL. With crew, 10,000 lb. of fuel and 18 passengers, the gross weight approximated 48,000 lb. Along with the AVIATION WEEK pilot were W. S. "Bill" Longhurst, chief engineering test pilot for Canadair, and A. F. J. "Bud" Scouten, chief pilot in production flight test.

As with all turbines, starting procedures are relatively simple and both engines quickly fired up. The demonstrator carried a self-contained electric starter, not too practical because of its 1,200 lb. of weight. Production models will be started by compressed air, either by a ground supply truck connected to the left-hand engine nacelle or a Blackburn Palouste gas-turbine compressor unit carried in this nacelle.

Compressed air is fed to both engines, where it impinges on the buckets of an air starting turbine, spinning the spool up to starting speed. (In-flight restarting is by unfeathering the propeller blades and windmilling up to engine re-light speed.)

The Palouste compressor unit is not affected by weather, AVIATION WEEK was told, and can make any number of starts. It uses fuel out of the aircraft system and operates on the 24-volt d.c. system. Unit, an optional item, costs an

A NEW DEVELOPMENT OF AERO SUPPLY MFG. CO. INC.
This drag chute release is but one example of our abilities and capabilities in the area of original electro-mechanical design. Aero Supply has supplied a wide variety of control devices since the very earliest days of commercial and military aviation.
DRAG CHUTE
RELEASE
DRAG CHUTE
Our basic engineering group specializing in original electro-mechanical design accepts complete responsibility for developing a component or system which will more than meet your specification sheet or problem statement. It is usual for us to design a unit which will solve your problem in the lightest and smallest package. To this custom engineering service is added superior test facilities and manufacturing abilities streamlined for limited or mass production.
REQUEST BULLETIN #59-126 AND OUR COMPLETE CAPABILITIES REPORT
AERO
AERO SUPPLY MFG. CO. INC.
CORRY, PENNSYLVANIA
ELECTRO-MECHANICAL DEVICES • ENGINEERED FLUID CONTROL SYSTEMS • PRECISION MANUFACTURING

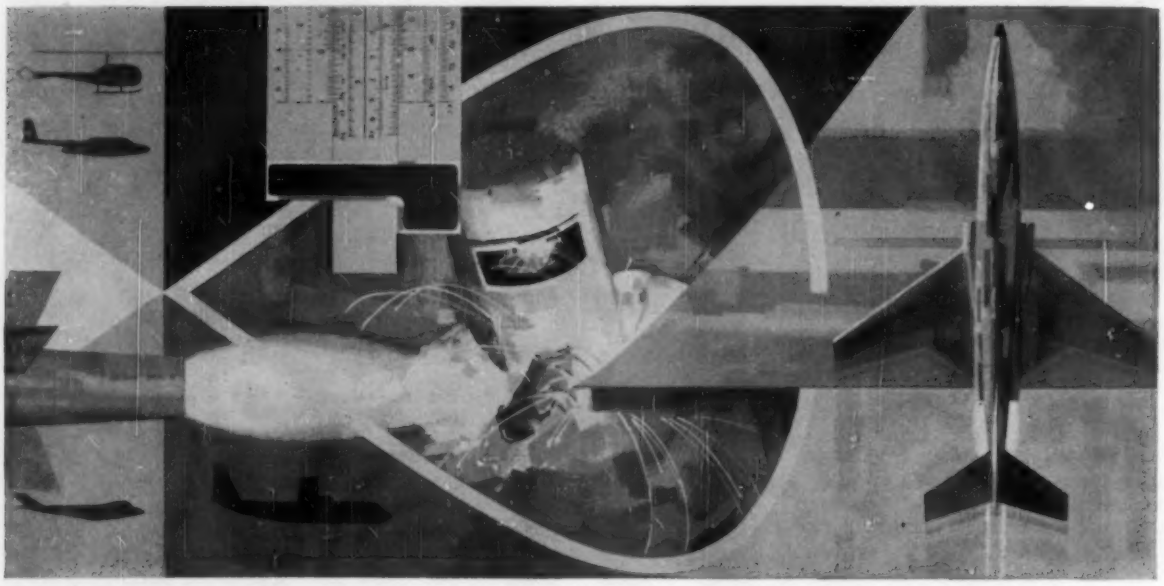
TEMCO
AIRCRAFT-DALLAS

FROM DESIGN
TO PRODUCTION
TEMCO
FOLLOWS THROUGH

Temco is regarded by its customers as a follow-through company . . with solid performance in every aspect of the contract from design to production. We consider it our business to be a partner on the job . . to cooperate willingly, to communicate freely.

Temco follows through by keeping top management and the customer informed on overall progress and program status. It follows through on quality control . . on materials during testing without waiting for a go-ahead on the next move. It naturally follows that Temco delivers a quality product, on schedule, and at the lowest possible cost.

For many years Temco has grown in the fields of subcontracting and aircraft modification. In addition it is rapidly developing its own proprietary products and participating in prime weapons systems development. It has the management, the capabilities, integrated skills and facilities to design, develop and produce for the electronics, aircraft and missile industries. Whether you need a component, subsystem or complete system, team up with Temco . . Temco follows through.



SYSTEMS MANAGEMENT	ELECTRONICS • AIRCRAFT • MISSILES
DIRECTED RESEARCH	
DEVELOPMENT	
PRODUCTION	

Napier 504A Eland Engines

Engines: Two Napier 504A Eland 6 turboprops with gear ratio of .0912:1. Propellers are de Havilland 13 ft. 6 in. dural, four-bladed, full feathering, hydromatic.

Average Engine Performance

Sea Level Static:				
Takeoff	**12,500 rpm.**	**3,230 shp.**	**3,500 ehp.**	**0.609 lb. fuel/ehp./hr.**
Max. continuous	**12,000 rpm.**	**2,665 shp.**	**2,905 ehp.**	**0.631 lb. fuel/ehp./hr.**
Altitude (20,000 ft., 325 mph.):				
Max. power	**12,000 rpm.**	**1,860 shp.**	**2,050 ehp.**	**0.549 lb. fuel/ehp./hr.**
Typical cruise	**11,750 rpm.**	**1,720 shp.**	**1,865 ehp.**	**0.557 lb. fuel/ehp./hr.**

additional $21,000, installed. With props at 10,000 rpm., the 540 was taxied smoothly and swiftly to runup position. Nose wheel steering is via a wheel at the forward edge of the left-side console. Quick disconnect permits the nose wheel to swivel 360 deg. during ground handling.

Wind at takeoff was from the north at 10 kt. Outside air temperature was 6C. Sea level pressure was 30.18 in. Elevation of Westchester County Airport is 441 ft. Fifteen degrees of flaps were lowered and the airplane was ready to roll.

At 12,500 rpm. the 540 accelerated quickly down the runway. Critical engine failure speed (V_1) is 97 kt.; takeoff safety speed (V_2) is 107 kt. The airplane was airborne after about 1,700 ft. of roll, at 120 kt. Initial climbout was held to this speed until the gear fully retracted (maximum speed during retraction is 130 kt.) and gear doors closed.

Result was high initial angle of climb, with rate in excess of 2,000 fpm. Helper jacks will be available on production models, which will force quick gear door closing, and permit a greater initial buildup in airspeed, plus a normal climb angle.

Normal climb was made at 140 kt. indicated, at 12,000 rpm. While noise level was moderate in cockpit during taxi, it was comfortable once the propellers were advanced to constant speed. At 4,000 ft., the rate of climb was 2,000 fpm.

Fuel flow was 210 gph. Torque pressure was 350 lb. Tailpipe temperature was 550C.

The airplane was temporarily leveled off at 5,000 ft. until we ran out from under cloud base. Straight and level at this altitude the 540 indicated 240 kt. until climb could be resumed to cruise altitude of 10,000 ft.

Normal cruise at 10,000 ft., at 11,500 rpm., produced an indicated speed of 225 kt. Outside air temperature was 5C. True airspeed was 266 kt., or 306 mph. Tailpipe temperature was 500C. Torque pressure was 265 lb. left, 295 lb. right (pressurization on right engine). Fuel flow was 155 gph. Cabin altitude was 1,000 ft. Flying characteristics of the 540 are good. Stability is excellent. Power of the Eland 6 turboprop was again pronounced when the left engine was shut down and feathered. Right engine was advanced to 12,000 rpm., and varying degrees of bank were made left and right, with no pilot strain and with light pressure on the right rudder following feathering.

Rpm. was advanced to 12,500. With gear down and 15 deg. of flaps lowered, single-engine, a climb of 300 fpm. was initiated at speed of 120 kt. indicated. Four degrees of rudder trim were cranked in.

Airplane was then nosed up into stall, following buffet at 95 kt. Lateral control was excellent.

Feathering Procedure

Left engine was brought back in at 140 kt. Maximum airspeed for unfeathering is 155 kt. Procedure here is also simple. With the boost pump on, ignition switch to "relight," the condition lever is placed in "run" position. The feathering button was pulled out and light-up was achieved in a few seconds. Power was then adjusted. On takeoff, full feathering would be automatic after engine failure.

With both engines pulled to idle, gear down and full flaps lowered, the airplane again was pulled into stall. Buffeting began at 80 kt. indicated; the wheel was held all the way back. Airplane just buffeted down; rate of descent was about 1,000 fpm. Minimum control speed for the 540 is 94 kt.

Normal descent was made at 10,500 rpm. Rate was adjusted to 1,500 fpm. Speed during descent was 240 kt. indicated. Airspeed indicators are yellow-lined at 260 kt. V_{no} (maximum, normal operating to 12,200 ft.) and are red-lined at 293 kt. V_{ne} (maximum, never exceed to 12,200 ft.).

Approach speeds for this airplane are not high. Gear was dropped on downwind at 170 kt. (max. for extension is 174 kt.), and 15 deg. flaps lowered. Base was flown at 120 kt., flaps to 24 deg. Speed on final was 110 kt., flaps to full. Airplane came over the fence at 101 kt. and touched down about 84 kt.

The Napier Eland powerplant is composed of four replaceable self-contained units: reduction gearbox, compressor and main support plate, combustion system and a three-stage reaction turbine which drives the constant-speed propeller through an epicyclic reduction gear.

Engine air intake is continuously anti-iced by oil heating of the walls (the inner diameter by splash from the gears; the outer diameter together with the spats by circulating hot scavenger oil through jackets). Intake lip is electrically anti-iced.

The 10-stage axial flow compressor is preceded by a row of inlet guide vanes, anti-iced by hot air tapped off the com-

Canadair-Convair 540 Performance

Takeoff field length (CAR)	**4,550 ft.**
Time to climb to 10,000 ft. (53,200 lb.)	**6.4 min.**
Time to climb to 20,000 ft. (53,200 lb.)	**15.6 min.**
Cruise speed at 20,000 ft. (46,000 lb.)	**322 mph. (280 kt.)**
Single-engine ceiling (50,000 lb.)	**10,300 ft.**
Landing field length (CAR)	**4,020 ft.**
Design diving speed	**375 mph. EAS (316 kt.)**
Diving speed (placard) V_{ne}	**338 mph. EAS (293 kt.)**
Design cruising speed V_c (47,000 lb., zero fuel)	**300 mph. EAS (260 kt.)**
Normal operating speed V_{no}	**300 mph. EAS (260 mph.)**
Payload-range fuel reserve for 200 mi., plus ¾ hr.:	
With 48 passengers @ 225 lb. each	**10,800 lb.**
Range including baggage, freight, mail	**900 stat. mi.**
With 58 passengers @ 200 lb. each	**11,600 lb.**
Range—for coach operations	**780 stat. mi.**
With 24 passengers @ 210 lb. each*	**5,040 lb.**
Range, including baggage, at 11,750 rpm.*	**1,700 stat. mi.**
Range, including baggage (long range cruise)*	**1,950 stat. mi.**
Range, with center wing fuel cells (optional),* long range cruise (with payload of 2,300 lb.)	**2,550 stat. mi.**

(* 24-passenger executive version having operating weight empty of 33,700 lb.)

The Record Breaking Rotodyne

191 m.p.h. *proved world's fastest rotorcraft*

Fairey's Rotodyne vertical take-off airliner has established itself as the fastest rotorcraft in the world. On 5th January, 1959, it flew round a 62 mile closed-circuit record course at an officially observed average speed of 191 m.p.h. for a new world convertiplane speed record — at *cruising* power and *operational* weight.

This record, almost 50 m.p.h. faster than the corresponding helicopter record and 30 m.p.h. faster than the absolute speed record for helicopters, confirms Fairey's claim that the true V.T.O. airliner is here — for city-centre to city-centre journeys, needing no expensive airfields, wasting no valuable time. Support of this claim is evidenced by the recent letter of intent for purchase of the Rotodyne by New York Airways.

(Confirmed by F.I.A.)

FAIREY *Rotodyne*

Powered by Napier Eland turbo-props

THE FAIREY AVIATION COMPANY LIMITED
HAYES · MIDDLESEX
ENGLAND · AUSTRALIA · CANADA

American Licensee:
THE KAMAN AIRCRAFT CORP.
BLOOMFIELD, CONNECTICUT

540's Specifications

Wing Group:	
Wing span	105 ft. 4 in.
Wing area	920 sq. ft.
Root chord	13 ft. 6 in.
Tip chord	4 ft. 6 in.
Taper ratio	3:1
Aspect ratio	12
Length	79 ft. 2 in.
Height	28 ft. 2 in.
Tread (main wheels)	25 ft.
Fuel capacity	2,032 gal.
Passenger Cabin:	
Length	39 ft. 9 in.
Width	8 ft. 10.5 in.
Height	6 ft. 7 in.
Volume	1,973 cu. ft.
Cabin pressure differential	4.16 psi.
Floor strength (passenger version)	75 lb./sq. ft.
Floor strength (cargo version)	300 lb./sq. ft.
Baggage compartment volume	402 cu. ft.
Seats (first class and tourist)	48 and 58
Seat spacing	38 in. and 34 in.
Max. zero fuel weight	47,000 lb.
Max. takeoff weight	53,200 lb.
Max. landing weight	50,670 lb.
Max. weight payload	13,178 lb.
Manufacturer's weight empty	32,224 lb.
Operating weight empty	33,822 lb.

pressor delivery. Incident angle is automatically varied at low engine speeds. Compressor blades are made of aluminum-bronze.

The compressor delivers to six-straight-flow, interconnected, tubular combustion chambers fitted with fixed-orifice, up-stream-injection burners. Engine control is effected through a Napier fuel metering unit interconnected with the propeller governor.

Compound epicyclic reduction gear incorporates a hydraulic torque meter and is housed in a magnesium alloy casing that forms the air intake. Torque meter is accurate to within 1% of the calibrated dynamometer readings over the normal power range.

Engine accessories are mounted on the reduction gear casing and disposed in two groups around the compressor. The top group, including a drive capable of transmitting 250 hp. to an aircraft accessory gear box, is driven by a spiral bevel gear from the front end of the compressor shaft. The bottom group is driven from the propeller shaft.

All 540 controls are operated via cables and push-pull rods. Ailerons and elevators are directly connected to the pilots' controls. The rudder is servo-operated. All surfaces have servo trim tabs.

Flaps are Fowler type.

The hydraulic system is of the closed center type operating at 3,000 psi. Pressure is supplied by two engine-driven pumps. System actuates the gear, brakes, nosewheel steering, flaps, entrance door, windshield wipers, ground heating and cooling blower. Auxiliary pump is electrically driven. Gear and brakes can be activated in an emergency by an air bottle.

Electrical power is supplied by two engine-driven generators of 375 amp. capacity at 24 to 28 v. Also installed is an engine-driven three-phase a.c. generator rated at 40 kva.

Heat obtained from engine tailpipe heat exchangers is utilized for wings and empennage anti-icing. Propellers and air intakes are also electrically heated.

Canadair has converted three Convair 440s to date. Two of these are on loan to the Royal Canadian Air Force, the third is used as a demonstrator. Ten Eland-powered Convairs – designated CL-66–are being built for the RCAF.

The 540 also is a leading contender to win a bid from Alleghany Airlines, which next year will introduce a turboprop fleet (AW April 6, p. 38). Canadair has set up the 540 parallel with military production. Rate, which can be increased, initially will be one per month. Lead time for delivery of a new airplane is 15 months; for a conversion, five months.

About 26 engines per month are being turned out by Napier at Liverpool, England. Overhaul time authorized by United Kingdom's Air Registration Board is currently 400 hr. Napier expects to boost this figure to 600 hr. by the end of this year, and expects 1,000 hr. between overhauls by December of 1960.

Canadair offers customer support on airframe and spares from its Montreal facilities. Engine overhauls will be handled by Canadian Pratt & Whitney Aircraft Co. U.S. overhaul facilities, on both coasts, will be established at a later date by Napier. Engine parts may be ordered through Napier's Washington office.

Military version of the 540 has a cargo loading door 120 in. wide by 72 in. high. Cargo floor, with strength of 300 lb./sq. ft., is beefed up in certain areas to withstand a 1,000-lb. load on one square foot. With wing tanks inboard of nacelle (bladder tanks), fuel capacity would be boosted to 2,565 gal. Airplane would gross 57,650 lb.; have a ferry range of 3,400 stat. mi.

Canadair offers the executive 540 with custom-built interiors, priced from $75,000 to $125,000. Basic executive model, with 24 seats, would have an operating weight empty of 33,700 lb. Range, with center wing fuel cells (optional at added cost), would be 2,550 stat. mi.

For your immediate use

the 6 most vital assets

to insure your

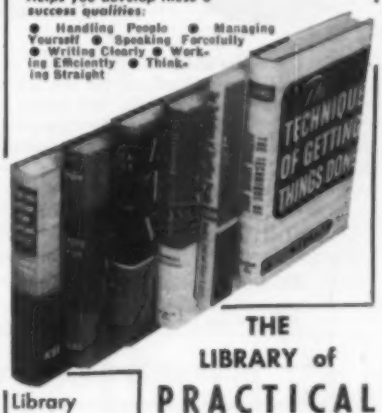
EXECUTIVE SUCCESS

SUCCESSFUL executives will tell you this simple fact: certain *key abilities* practically allow a man to write his own paycheck. And one doesn't have to be born with these proven executive qualities—they can be self-developed to a degree you may never have thought possible—easily, and *without* long years of study. You can help yourself acquire them with this specially selected Library of practical executive techniques.

The six books comprising this Library have been selected by successful executives as the ones *most useful* in developing the six qualities of executive success.

Helps you develop these 6 success qualities:

● Handling People ● Managing Yourself ● Speaking Forcefully ● Writing Clearly ● Working Efficiently ● Thinking Straight



THE LIBRARY of PRACTICAL EXECUTIVE TECHNIQUES

Library contains these books:

Managing Yourself by Wright . . . *The Technique of Getting Things Done* by the Lairds . . . *How to Develop Your Thinking Ability* by Keyes . . . *The Technique of Clear Writing* by Gunning . . . *How to Talk Well* by Bender . . . and *The Technique of Handling People* by the Lairds

● 6 volumes ● 1633 pages ● $21.50 — payable $6.50 in 10 days, then $5.00 a month

You'll find here the best thinking on a variety of important executive techniques . . . like getting the best out of your associates, putting your thoughts down clearly and forcefully on paper, speaking with authority in front of people, thinking a job through logically, and getting it done most efficiently. All in all, you have a storehouse of information on doing *best* every job the successful executive must know how to handle.

SAVE $5.95. Bought one at a time, the total price of these books would be $27.45. Under this special offer, the complete Library is available for only $21.50—a cash saving of $5.95. And you also have the privilege of paying for the books on easy terms, while you use them.

SEE THIS LIBRARY 10 DAYS FREE

McGraw-Hill Book Co., Dept. AW-4-20
327 W. 41st St., N. Y. C. 36

Send me the Library of Practical Executive Techniques for 10 days' examination on approval. In 10 days I will send $6.50 then $5.00 monthly until $21.50 is paid. Otherwise I will return books postpaid.

PRINT
Name.....

Address.....

City..... Zone... State.....

Company.....

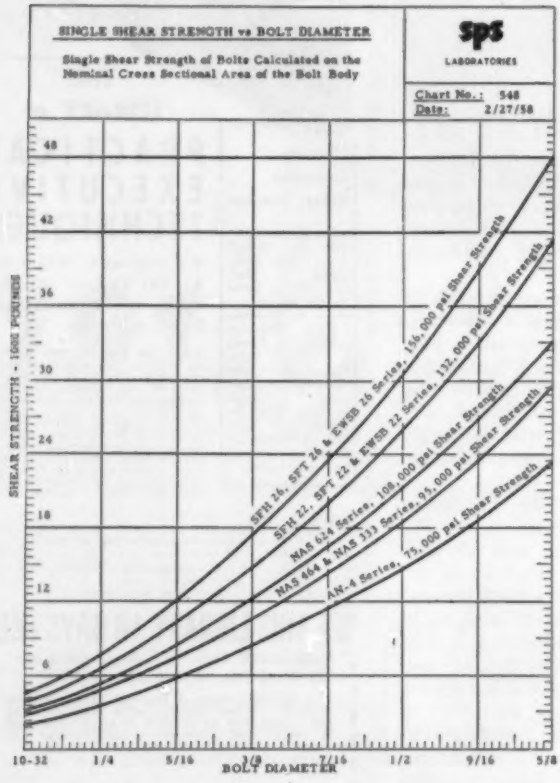
Position.....

For price and terms outside U. S., write McGraw-Hill Int'l., N. Y. C. AW-4-20

New SPS super high strength shear fasteners save you 25-50% in shear bolt weight

132,000 and 156,000 psi units are strongest standard shear fasteners ever offered

New SPS super bolts and companion locknuts are the strongest shear fasteners ever offered the aircraft-missiles industry, permit significant reductions in size and weight of threaded joints. Three different wrenching configurations are available, any one of which will induce over 50% of ultimate fastener strength. Units are serviceable to 550°F.



Greater shear strength. Graph shows shear strength in pounds for various diameter sizes of different shear bolts. Top two curves plot the new SPS super high strength shear bolts, available in 132,000 and 156,000 psi series. Remaining curves represent current aircraft industry standards.

These new SPS shear bolts are 39 to 64% stronger than the best standard shear fasteners now in use. They automatically save you 25 to 50% in shear bolt weight, because they can be substituted for conventional fasteners one to two diameter sizes larger... with no compromise in reliability.

For example, one of the new ½ in. diameter, 156,000 psi shear bolts, capable of design loading of 30,000 lb., does the structural job of a ⅝ in. NAS type weighing nearly 30% more. On a large airframe this can mean a saving of several hundred pounds. Further, the use of smaller fasteners often permits miniaturization of related parts in a joint, resulting in additional weight savings.

The new bolts are forged from 5% chrome high strength steel, then heat treated to 220,000 psi tensile for the 132,000 psi shear series and to 260,000 psi tensile for the 156,000 psi. Both series are available in standard sizes #10-32 through ⅝-18, with companion locknuts of new design. The 132,000 psi shear bolts have a cadmium-fluoborate plating, the 156,000 are vacuum cadmium plated. For complete information, write Aircraft/Missiles Division, STANDARD PRESSED STEEL Co., Jenkintown 3, Pa.

HIGH RELIABILITY

SPS research is continually developing fasteners with higher standards of predictable performance. By installing SPS high-reliability fasteners in your assemblies, you increase overall product reliability.

For more information on the full meaning of reliability, write for a copy of the new SPS booklet "High Reliability."

We also manufacture precision titanium fasteners / write for free booklet

SPS Jenkintown • Pennsylvania

Standard Pressed Steel Co. • The Cleveland Cap Screw Co. • Columbia Steel Equipment Co. • National Machine Products Co. • Nutt-Shel Co. • SPS Western • Standco Canada Ltd. • Unbrako Socket Screw Co., Ltd.

Commuter Service Aimed at Executives

By Erwin J. Bulban

A scheduled commuter-type airline service, developed by a New York business aircraft dealer who is tailoring the operation to meet corporation local travel needs, has passed its initial phase successfully and is being expanded to handle higher traffic volumes.

During the first phase, which started last August, Tri County Airways carried more than 2,000 executives until recently when new equipment was added to handle traffic volume.

The operation provides five-days-a-week service from Westchester County Airport, where Tri County is based, to Binghamton, N. Y. Departures from Westchester every day are at 7:30 a.m. and 5 p.m.; return flights from Binghamton leave at 9:35 a.m. and 7:05 p.m.

Tri County Airways' President W. E. Nichols, Cessna Aircraft Co. dealer at Westchester, sees the operation as enabling him to tap a substantial market of businessmen who need the time-cutting features of flying but who, in most cases, are not prospects for airplane ownership. It is the executive who needs air transportation that Nichols wants as a customer for his service—he is not interested in building mass traffic volume by encouraging the non-executive traveling public. Nichols is selling the operation as a corporate flight service and is making his sales pitch at companies in the Binghamton and White Plains area.

Nichols made his initial effort at International Business Machines, whose personnel constitute a good-sized weekly traffic potential between plants in Binghamton and several facilities in an area of 5 or ten mi. of Westchester County Airport and the company's world headquarters in New York City. Current transportation required that the executives either take a train the night before and spend the night in a hotel or fly Mohawk Airlines to Newark Airport and then retrace their way to White Plains.

Nichols had considered the service some two years ago but delayed his try-out because he thought that Mohawk was going to build up its "southern tier" route pattern to include Binghamton-White Plains (Westchester County Airport) service. At a business luncheon early last year a Mohawk representative stated that this service was not going to be activated. This and a conversation Nichols had with an IBM executive encouraged him to push his plans to start Tri County service with an eye to first serving the IBM executive travel market and also interesting other companies in the area.

Tri County started out in August with a five-passenger Twin Beech on a twice-daily five-days basis. To ensure that he didn't tread on any toes he worked with IBM's own aviation department, headed by Charles A. McKinnon, which surveyed his plans and checked out the operation.

Tri County works through three sources at Binghamton in securing reservations: IBM traffic department, a travel agency in town and the limousine service at the airport. An IBM executive can pick up his ticket at the plant the day before, or at the airport.

Business developed to the point where Tri County was averaging some 69-72 seats filled a week out of a total of 100 in the Twin Beech and there were days when he had more prospective passengers than seats. Nichols noted that you can't build this kind of service if you have to turn people away, particularly if the same people are turned away several times. The service maintained approximately 93% schedule frequency in its initial phase. Next step was to get bigger capacity equipment and in this second phase of the operation Nichols utilized a four engine de Havilland Heron 2 with triple the Twin Beech's seating capacity. Tri County Airways leases the Heron, because Nichols is playing a conservative game and doesn't want to tie up a lot of capital at this stage of the operation.

The operation is primarily based on using instrument flight rules flight plans to maintain crew proficiencies and enhance the professional tone of the service. Crews wear uniforms. Insurance provides each passenger with $100,000 worth of life insurance plus a comprehensive policy with $1 million single-limit coverage.

Tri County Airways operates under Civil Aeronautics Board certificates permitting flight operations anywhere in the United States, Canada, Mexico and the Caribbean. Nichols sees the next possible extension of its service running to Washington, D. C., and to Boston, still maintaining close relationship with corporations to stress executive travel.

U. S. Business & Utility Aircraft Shipments

February 1959

Manufacturer and Model	No. of Units	Net Billings
Aero Design 520	6	$742,000
680E	0	
680E	5	
Beech E18S	6	$1,913,000
Bonanza	32	
Twin-Bonanza	2	
Travel Air	8	
Call Air A5	5	$63,000
A6	3	
Cessna 150	56	$3,748,000
172	39	
175	67	
180	23	
182, Skylane	67	
310C	24	
Champion 7EC	7	$107,000
7FC	10	
7GC	4	
Colonial C-2 Skimmer IV	1	$19,000
Fairchild F-27	1	$1,350,000[1]
F-27A	1	
Helio H-391B Courier	2	$150,000
H-395 Super Courier	3	
Mooney Mk. 20	13	$149,000
Piper PA-18	12	$2,878,759
PA-18-A Super Cub	32	
PA-22 Tri-Pacer	49	
PA-23 Apache	30	
PA-24 Comanche	91	
Totals	599	$11,146,000

[1] F-27 totals represent direct factory sales at retail.
January-February total business and utility aircraft shipment represent 1,240 units having total net billing value of $27,442,000.

Bonanza Tip Tanks Approved

All-metal tip tanks, each holding 13 gal. of fuel, extend range of Beech Bonanza business plane by 450-500-mi. Endplate effect provides a noticeable improvement in airplane's handling characteristics, particularly in rough air, according to Doman Helicopters, Inc., Danbury, Conn., which engineered the installation. Marketing is handled by Safe Flight Extenders Co., Stamford, Conn., which has received Federal Aviation Agency certification of the installation and is selling complete wingtip tank kits for $675. Tanks have internal baffling, weigh 7.75 lb. each. No structural changes are required for attachment.

PRIVATE LINES

Burlington Industries received delivery of Convair 240 executive conversion, initially purchased from Frederick B. Ayer & Associates and reworked by AiResearch Aviation Service Division to provide seating for 19 passengers. Plane is equipped with Bendix X-band radar, Sperry A-12 autopilot and Janitrol heating system.

Consolidated sales of $5,096,081 are reported for Pacific Airmotive Corp. and its subsidiaries for the quarter ended Feb. 28, compared with $5,656,481 for similar period last year. Unaudited figures indicated net profit of $5,938 compared with 1958 first quarter of $35,407. Commercial sales volume, which company is now emphasizing, was more than $600,000 ahead of the same period in 1958.

Gross revenues of $3,188,382 are reported by Okanagan Helicopters, Ltd., for year ended Dec. 31, 1958, with net earnings being $245,402. The company operated 54 helicopters in 1958, including four leased aircraft, flying more than 24,000 hr., giving the company a total to that date of some 100,000 hr. of rotary wing operating experience. Okanagan group has 25 helicopters on long-term contracts, including DEW-Line support operations.

Helibarge experiments studying feasibility of increasing helicopter payloads by having them tow balloons which carry a major portion of the load, are being conducted by World Wide Helicopters, Ltd. Initial experimental trials conducted with natural shape balloons enabled a Bell Model 47 helicopter to lift payload four times that it could carry normally.

Dynamics Engineers

The opportunity is now available for you to join our Dynamics Science Section if you have dynamics experience or an advanced degree and a desire to become a member of Dr. Robert Laidlaw's group.

Openings exist for men qualified in aeroelastics, flutter and vibration, structural loads, acoustics, and analog analysis of dynamic problems.

The Columbus Division has developed the A3J Vigilante, and is now working on even more advanced projects, both missile and aircraft. Write to:

H. Keever
Engineering Personnel Manager, Box AW-131
North American Aviation, Inc.
Columbus, Ohio

THE COLUMBUS DIVISION OF

NORTH AMERICAN AVIATION, INC.

Home of the T2J Jet Trainer and the A3J Vigilante

Marker Unit

No separate power supply is required for this new 18-oz. Narco MBT three-light 75-mc. marker beacon receiver, only connections needed being a connection to the aircraft antenna and another to the aircraft's normal electrical power source. Unit draws only 0.005 amp., leading Narco engineers to suggest that it be connected directly to the aircraft's master switch for full-time operation. In addition to providing white, blue and amber light indication, the MBT can be connected to a cabin speaker amplifier or headset for aural signal. Priced at $230, it comes in 12-v. and 24-v. models. Dimensions are 1¼-in. x 3¾-in. x 6-in. deep. Maker is National Aeronautical Corp., Ft. Washington, Pa.

VIGILANTE

The Navy's new all-weather attack weapon system packs a precision punch... for limited war, or all-out conflict

When North American's A3J Vigilante joins the fleet, the Navy will have its first supersonic carrier-based attack weapon system.

Vigilante is so versatile it can strike the restricted targets of limited warfare with extreme accuracy in any kind of weather—or deliver a knockout blow in all-out conflict. It can handle almost any kind of armament, including nuclear weapons, at extended strike ranges, high or low level. In performance, it's on a par with the fastest, highest-flying airplanes in the world today—yet it also operates with superior efficiency for low-altitude, long-range missions. Advanced boundary-layer control and full-span movable leading edge give the A3J good low-speed handling qualities for safe landings on carrier decks and short runways ashore.

The A3J is a true weapon system. All electronic systems and auto-flight controls are integrated, and were designed to enable the A3J to carry out all-weather, all-attitude weapon delivery. Its precision bombing-navigation system—outstanding in tactical efficiency—is the result of a coordinated effort by North American's Columbus and Autonetics Divisions.

Most important—the A3J has *men*: a pilot and a bombardier-navigator. For only men can respond to the unexpected. Only men can make decisions and report results. Only men can think. That is why, now and in the future, we must have manned weapon systems like the A3J Vigilante to keep our defense in balance.

Also from Columbus—a new concept in Navy basic training

North American's new T2J is more than just a rugged, reliable, safe, easy-to-service jet trainer. It is an airplane specifically designed to meet the high standards set by the Navy for training carrier pilots. Top speed is 424 knots; stall speed is under 75. Engine can be removed in 7 minutes, replaced in 20. The T2J was designed, engineered, tested—and is now being produced—at the Columbus Division.

THE COLUMBUS DIVISION OF NORTH AMERICAN AVIATION, INC.

Columbus, Ohio

CAB Accident Investigation Report:

Unintentional Spin Causes Beech Crash

A Beechcraft Travel Air, model 95, N 819B, owned by the Central Flying Service, Inc., Little Rock, Ark., spun to the ground 25 mi. northwest of Little Rock, Ark., July 22, 1958, killing all four occupants.

There was no fire.

Takeoff was from Adams Field, Little Rock Municipal Airport, Ark., about 11 a.m. with four men on board: Willis D. Hill, General Operations Safety Inspector, Civil Aeronautics Administration; James H. McClellan, a pilot who was to be flight checked for a twin-engine type rating; and two passengers, Howard K. Gilbert and Jesse T. Williams. The check flight was to consist of various flight maneuvers such as takeoffs, landings, stalls, simulated engine-out emergency procedure, and single-engine operation.

This model aircraft is four-place, equipped with two 180 hp. engines and full-feathering propellers, and was type certificated by the Civil Aeronautics Administration[1]. The aircraft was relatively new, had been properly maintained, and was in good operating condition in all respects.

Subsequent to the accident the Board had the Beech Aircraft Corp. conduct a test program in which spins simulating the conditions of the accident, and spins under even more critical conditions, were demonstrated. Recoveries from these spins, which included those with a windmilling inside engine and a feathered outside engine, and a windmilling inside engine with power being developed by the outside engine, were satisfactory and well within the spin requirements of CAR 3.124. However, these spin tests did demonstrate that if the spin was entered at 1,000-1,200 ft. altitude complete recovery was not possible.

Witness opinion as to the altitude from which the spin started varied considerably and cannot be fixed closer than between 800 to 2,000 ft.

INVESTIGATION

Pilot McClellan held a valid airman certificate with commercial and single-engine land ratings and a current medical certificate. He was relatively inexperienced in light twin-engine aircraft; evidence indicates that his piloting time in such aircraft was 10 hr., of which 5 hr. was in the Beech Model 95. His total piloting time in various types of single-engine aircraft was listed as 1,500 hr. on the CAA application form for multi-engine rating.

CAA Inspector Hill had logged 5,341 flying hours but had done an unknown amount of other, and unlogged, piloting. To qualify for giving "light twin" engine rating flight checks, Hill had completed the Civil Aeronautics Administration's "light twin" checkout program in September, 1956. During this course he flew the Piper Apache three hours, and the Cessna 310 two hours. On Nov. 13, 1956, he completed a second course at the Civil Aeronautics Administration Aeronautical Center in Oklahoma City, Okla., entitled "Aircraft Characteristics and Performance Below 12,500 Pounds."

During this course he flew the Piper Apache 7 hr. and 10 min., the Cessna 310 8 hr. and 10 min., and the Beechcraft C-18 one hour. Hill had given 18 multi-engine flight checks since he had completed this course, of which five were in the 60 days immediately preceding the accident. The Beechcraft Travel Air, model 95, with a maximum weight of 4,000 lb., is classed as a light twin. Hill had about 440 multi-engine flying hours, but no recorded time in this model aircraft.

Passengers

Passengers Gilbert and Williams, who were occupying the two rear seats, were both pilots. Their riding during the check flight was not contrary to regulation. They were aboard for familiarization with the check flight as one of them was shortly to take a similar test and the other was being indoctrinated as a CAA flight test designee.

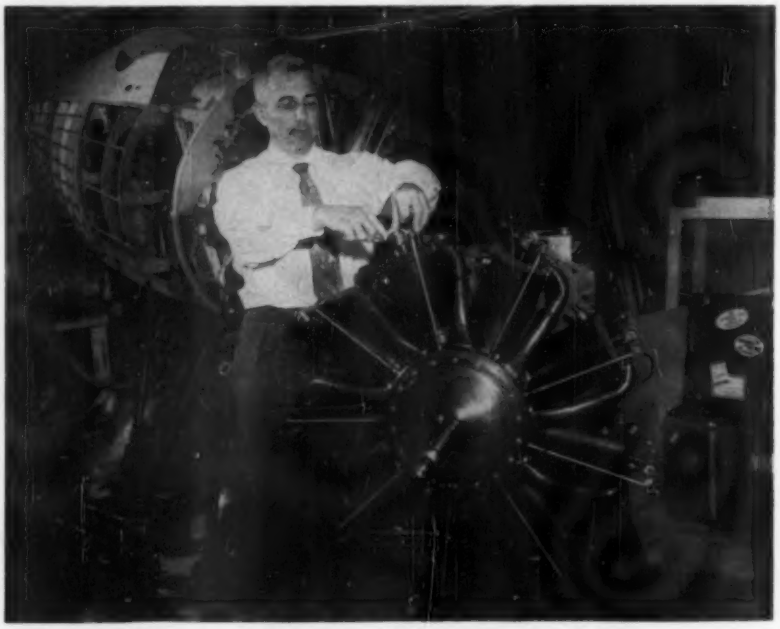
Prior to takeoff Inspector Hill briefed Pilot McClellan on the forthcoming flight. This briefing included a discussion of a number of items in the operator's manual and in the aircraft flight manual. It included other factors such as the best rate-of-climb speed, the best angle-of-climb speed, and single-engine minimum-control speed. There was testimony indicating that this briefing lasted for approximately one hour.

The flight called the control tower for taxi instructions at 1054 and was cleared to runway 35. After reaching the runup area both engines were run up. At approximately 1102[2] the aircraft took off, flew the traffic pattern, and landed. Immediately thereafter, clearance for a second takeoff on runway 35 was requested and granted; the aircraft then took off and departed the Adams Field traffic pattern at approximately 1109.

The aircraft was observed by several witnesses shortly before 1200 some nine miles west of Mayflower, Ark. None had any aeronautical experience and they gave varying versions as to the altitude and attitude of the aircraft. They agreed, however, that the airplane nosed down and started spinning. Two witnesses said that the aircraft spun to the right; five said it spun to the left. Two witnesses observed the aircraft strike the ground and stated it spun until ground contact. They also stated that the tail bounced up and then fell back down. The other witnesses were unable to see the

[1] The term CAA (Civil Aeronautics Administration) rather than FAA (Federal Aviation Agency) is used herein because this accident occurred prior to Dec. 31, 1958.

[2] All times herein are central standard based on the 24-hr. clock.



His Business Is Aircraft Antiques

Specialist in collecting and rebuilding antique aircraft and engines, North American Aviation preliminary design section group leader Jack Canary currently has en route to his El Segundo, Calif., home 26 powerplants of 1918 vintage or earlier and is rebuilding a British Sopwith Snipe single-seater fighter of World War I. His rebuilt airplanes are all flyable and eventually find their way into museums and historical collections. Canary travels extensively, also going abroad, to add to his historical aircraft collection and library. Here he checks a 110-hp. LeRhone rotary engine which he acquired during a trip to France this summer.

aircraft strike the ground, due to obstructions, but all heard the impact.

The witnesses stated, in substance, that they heard the sound of the engine or engines running at reduced power until the aircraft struck the ground. There was some testimony that the engine noise increased just before impact. The altitude at which the spin started appears to have been between 800 and 2,000 ft. as estimated by these lay witnesses. In addition, two pilots who flew over the wreckage approximately 30 min. after the accident testified that the ceiling was about 2,500 ft. with broken clouds and visibility was between 10 and 12 mi. These conditions were substantially similar to those indicated by the Little Rock 1200 CST official U.S. Weather Bureau report except for broken clouds at 6,000 ft. in the Little Rock area.

Fuel Check

The statement of Pilot Richard M. Lieberman, who flew N 819B on the flight immediately preceding the accident, indicates that he visually checked the main fuel tanks and noted they were filled to capacity. The fuel gage in the cockpit indicated that the auxiliary tanks were also full at this time. Mr. Lieberman's flight lasted .85 hr., after which the aircraft was serviced with 19.9 gal. of gasoline. Since the aircraft should use approximately 19.9 gal. of fuel for a flight of this duration, it is indicated that all tanks were full when Messrs. McClellan and Hill took off.

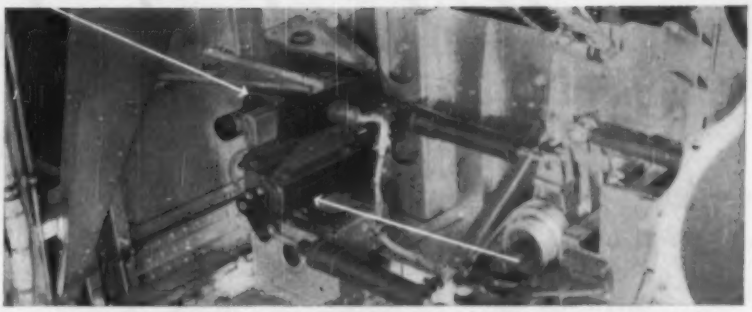
The gross weight of the aircraft at takeoff was approximately 4,000 lb., or the maximum allowable gross takeoff weight. The center of gravity was located within the allowable limits, approximately 1.3 in. forward of the rearward limit.

The crash site was a cornfield on a flat river-bottom land, soft from recent rains. The airplane had contacted the ground in a slightly nose-low attitude while descending nearly vertically. There was evidence of some forward motion and some motion to the right; however, the predominant direction of movement was downward. The aircraft initially struck the ground on a heading of 127 deg. magnetic, and then, except for the empennage, pivoted counterclockwise on the right engine to a heading of 108 deg. The empennage which was torn almost free came to rest on a heading of 080 deg. The wreckage was not scattered, showing the predominant vertical motion at impact.

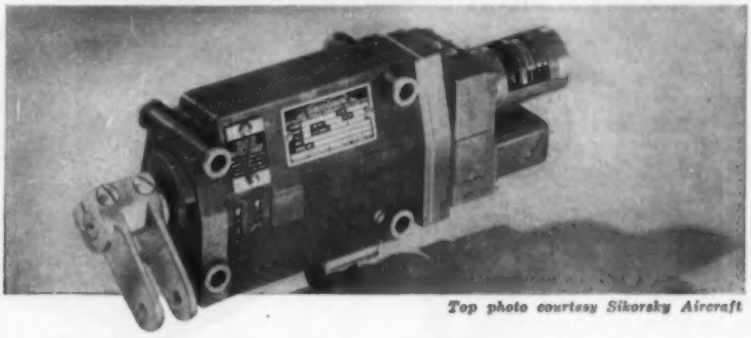
Spinning Movement

Attesting to the left spinning movement, the force of the impact threw the body of the check pilot, who occupied the right front seat, to the right and to a position outside the cabin and adjacent to the right engine. The body of the passenger in the right rear seat was also thrown to the right and to a position on the right wing near the tip. The bodies of the pilot, who occupied the left front seat, and the passenger, who occupied the left rear seat, were found in the wreckage, but to the right of their respective seats.

Except for the tail surfaces the entire aircraft was extensively damaged by the severe ground impact. The nose section was crushed and bent upward approximately 20 deg. and the entire lower fuselage area was



Trim system of Sikorsky HUS-1 and HSS-1N helicopters utilizes two special Airborne rotary actuators, acting through force gradient springs, to position and hold cyclic sticks. Pilot can override springs to maneuver; then have stick return automatically to trimmed position.



Top photo courtesy Sikorsky Aircraft

Airborne special actuators provide helicopter trim control

One of the more recent applications of Airborne special design actuators is found on Sikorsky's HUS-1 and HSS-1N helicopters. Two Airborne R4610 TRIM TROL units are used on these aircraft as moveable anchor points for a force gradient system of trim control. The system is an ingenious one, offering the pilot several control options.

For example, to make a quick maneuver, he can override the force gradient springs manually, without disengaging the actuator clutches. When released, the stick then returns automatically to original position. Alternatively, he can disengage the clutches by pushing the stick trim button, thus removing the force gradient system from the controls while maneuvering to a new flight condition. In this instance, the stick remains spring centered in the new position when the button is released.

A third control option permits changing flight attitude by power. Using a "beeper" button, the pilot energizes the actuators to drive the stick slowly to a new trim position, where it remains centered when the button is released. Finally, the system can be disconnected entirely, leaving the stick free and without artificial feel.

A detailed description of this system and the actuators employed is contained in new Airborne Bulletin PS-3A, available on request.

LINEATOR® • ROTORAC® • TRIM TROL® • ROTORETTE® • ANGLgear® • ROTOLOK

AIRBORNE®

Engineered Equipment for Aircraft and Industry

AIRBORNE ACCESSORIES CORPORATION

HILLSIDE 5, NEW JERSEY • Offices in Los Angeles and Dallas

"Best individual effort...

...best combination of ideas"

At Convair-Fort Worth, you'll find a new outlook . . . a new perspective in the engineering organization . . . one whose objective is to provide a framework from which each engineer can contribute his best individual effort toward achieving the best combination of ideas.

This is one reason why so many experienced, well-trained men with creative ability and inquiring minds are taking a close look at the advantages of joining a team whose advanced thinking is so vividly portrayed by the all-new B-58, America's first and fastest supersonic bomber.

Living in Fort Worth has its advantages, too. There is no state income or sales tax, adequate housing in all price ranges, no commuting problem. Descriptive literature will be supplied on request, or send a complete resumé of your training and experience for careful evaluation by engineers in the areas best suited to your qualifications. To be assured of prompt attention and strict confidence, address your inquiry to P. O. Box 748A.

CONVAIR - FORT WORTH

A DIVISION OF

GENERAL DYNAMICS

also badly crushed. Both wings were crushed and wrinkled and each engine was nearly broken from its nacelle by impact forces acting upward and to the right. The cabin overhead structure collapsed downward and slightly forward, and the cabin sides bowed outward. The seats were deformed slightly and torn partially loose by high downward loads.

Examination of the wreckage accounted for all parts of the aircraft and determined that none were lost in flight. All doors and external openings were closed at impact and the landing gear, flaps, and step were retracted. All control surface balance weights were still attached, and the control surfaces, hinges, and bearings showed no evidence of damage before impact.

The flight control systems were generally intact and showed no evidence of malfunction or failure prior to impact. No evidence of flutter, fire, explosion, midair collision, bird strike, sabotage, excessive corrosion, or fatigue failure was found.

Examination of the powerplants disclosed that both were extensively damaged by impact as indicated by the crushed undersection of the engines and the twisted propeller blades.

There was no evidence of fire in or about the powerplants.

The two powerplants were transported from the scene to the maintenance facilities of Central Flying Service, Inc., at Little Rock, where a complete teardown inspection was conducted under the supervision of a Civil Aeronautics Board investigator. The teardown inspection indicates that the crankshafts and bearings and associated drive gears were intact, adequately lubricated, and free of indications of operating distress. All cylinder assemblies were in place on the engines and their interiors contained no evidence of combustion chamber irregularities.

Propeller Positions

Examination also revealed that the pitch-changing mechanisms of the left propeller were positioned in low pitch or the power off position for the left propeller. The No. 1 blade of the right propeller was found disconnected from its pitch-changing unit and in the low pitch position due to impact. The propeller pitch-changing cylinder and the No. 2 blade were found in the feathered position. In this instance neither propeller was feathered at the time of impact. This was evident because when the right propeller was dug out of its crater, a large quantity of oil was observed around the failed pitch-changing cylinder.

During constant-speed operation, the pitch-changing cylinder is full of oil. When feathering is selected, centrifugal force and spring action feather the blade and the oil in the cylinder drains back into the engine. Since there was a considerable amount of oil around the pitch-changing cylinder at impact, the propeller must have been in the constant speed range at time of impact.

If the propeller had been feathered at the time of impact the large amount of oil would not have been present and also the cylinder and cap would have shown indications of bottoming by the oil transfer tube and spring assembly. There were no such indications of bottoming on the cylinder assembly.

Examination of all propeller blades revealed impact distortions consistent with a no-power condition, which is normal procedure for spin recovery in this aircraft.

All rear mounted accessories remained in place on the engines. Both carburetors, which are mounted beneath the engine, were broken off at impact. Both throttle controls were damaged extensively and were broken off at impact. The positions of all other controls were consistent with a no-power configuration at the instant of impact.

The throttle valves were free. The mixture controls of both carburetors were extensively damaged at impact and were both found in the full rich position.

Maintenance Review

A review of the maintenance records of the aircraft indicated that a 25-hr. inspection was completed on May 27, 1958. In addition to this inspection, the oil was changed, battery checked, air filter cleaned, and the radio changed. The aircraft had accumulated 30.4 hr. at the time of this maintenance work. On June 7, 1958, the right engine intake air temperature gage was repaired after a pilot complaint. There were no later logbook entries. Maintenance, in short, had been adequate and of high quality during the 87:02 hr. total usage of the aircraft.

N 819B was equipped with a throw-over type of control wheel which permitted the aircraft to be flown from either the right or left front seats with operable pairs of rudder pedals available for both pilot and copilot. Examination of the broken throw-over wheel arm indicated that the wheel was positioned on the left side at impact. From persons who were at the scene very soon after the crash it was learned that none of the four safety belts was found fastened. With one exception none of the four safety belts exhibited signs of heavy loading as from impact. The exception was the rear left belt which appeared to have been cut during or after the impact. Examination at the accident scene of the belt webbings, anchor fittings, and the buckle assemblies also showed that these components were in good condition except for the webbing of one belt as described above.

The aircraft was equipped with a stall warning system which gave both aural and visual notice of approaching stall. Investigation disclosed that it was functioning properly during the previous flight a few hours before the accident. It should be noted, however, that in order to demonstrate minimum-control speed the aircraft normally has to fly in that speed range, which would activate the stall warning system.

Following the accident Beech Aircraft Corp. conducted certain spin tests in which a Civil Aeronautics Board representative participated, and confirmed the ability of the aircraft to recover readily from spins under the most adverse configurations. They show that under the existing loading a minimum of 1,200 ft. is needed for recovery from a fully developed spin to either the left or to the right with wing flaps and landing gear up. Neither engine power nor the feathering of one propeller has any significant effect on spin recovery characteristics.

Civil Air Regulations prescribe dual con-

IBM.

APPLIED SCIENCE . . .

a professional career that didn't exist ten years ago offers BROAD NEW OPPORTUNITIES

Ten years ago, the Applied Science Representative was almost unheard of. Today, at IBM, he has a "frontier" career with all the associated challenges, excitement, and opportunities to make rapid progress based on personal capabilities.

The IBM Applied Science Representative is a professional consultant to the top echelons of business, industry, and government management. He deals with the mathematical formulation of scientific and management problems and proves the feasibility of solutions with electronic data processing systems.

Successful men and women candidates will be given comprehensive training to equip them to direct their education and talents toward a successful career in Applied Science.

You can become an IBM Applied Scientist, if:

- you have an M.S. or Ph.D. in engineering, mathematics, or one of the physical sciences . . . or a B.S. in engineering, mathematics, or one of the physical sciences and a Master's degree in business administration.
- you have a B.S. in mathematics or one of the physical sciences, plus experience in computer programming.
- you are interested in exercising a free hand in assignments requiring fresh thinking and new, creative approaches.
- you are able to communicate ideas to technical and nontechnical people.
- you are interested in joining the leader in the fast-expanding electronic-systems field.

For further information, contact your nearest IBM branch office, or:

- Mr. W. F. McClelland, Manager of Applied Science, IBM Corporation, Eastern Region, 425 Park Avenue, New York 22, New York
- Mr. R. W. De Sio, Manager of Applied Science, IBM Corporation, Midwestern Region, 618 South Michigan Avenue, Chicago 5, Illinois
- Mr. L. C. Hubbard, Manager of Applied Science, IBM Corporation, Western Region, 3424 Wilshire Boulevard, Los Angeles 5, California

Applied Science Representatives are located in over 100 IBM branch offices throughout the country.

DATA PROCESSING DIVISION

600 pounds of missile ... tons of gray matter

The Bullpup, air-to-ground missile by Martin Orlando. Small, light . . . almost dainty compared to some monster missiles. Yet deadly! Fire one . . . mission complete.

That's because of the gray matter . . . tons, if you could measure it . . . poured into the Bullpup by the men of Martin Orlando. Every day these men grab fistfuls of the future . . . engineer it, program it through computers, reduce the data, design hardware, test it . . . and add it to the present.

Working in the finest R&D and production facility, located in sunny Orlando, Florida, these men probe the limits in electronics, propulsion, guidance . . . the complete spectrum of large weapons systems. Martin Orlando's chief asset is gray matter . . . clear, imaginative, experienced thought. And we can always use more. Come . . . and bring your gray matter.

Senior level openings for Electronic Engineers, Physicists, and Electrical Engineers in these design areas: pulse circuitry, electronic packaging, transistor circuitry, production test equipment, digital and analog computer. Opportunities for men experienced in calculating solid state parameters, molecular distribution and quantum mechanics. Send confidential resume to: J. F. Wallace, Director of Professional Staffing, The Martin Company, Orlando 23, Florida.

MARTIN
ORLANDO

A great name in electronics/missiles

trols for flight tests. Under these rules, the CAA inspector may accept the throw-over control wheel installation if he believes it satisfactory for a type rating test.

ANALYSIS

The exact maneuver that was being attempted at the time the spin started cannot be determined from physical evidence, but it may logically be deduced. Normally this type of check flight for rating lasts from an hour to an hour and a half. Maneuvers to be demonstrated to the satisfaction of the inspector are a simulated single-engine climb-out following a missed-approach, an engine failure on takeoff, and an engine failure at minimum-control speed. As the accident occurred after the check had been in progress for about an hour, and as these maneuvers are normally done toward the end of the flight, it seems entirely possible that one of these was in process when the spin started.

It is most unlikely that a spin was started at low altitude intentionally. Spins are not called for in either the testing for type certification of most twin-engine aircraft nor during check flights for type ratings. The Board is of the opinion the spin occurred unintentionally.

Examination of the wreckage indicated that the aircraft struck the ground in a left spin. The flight controls were capable of normal operation, the airplane was aerodynamically clean (flaps up, gear up, all openings closed), and no evidence of structural failure or deformation was found.

Spin Recovery

The spin-recovery characteristics of the aircraft are good so that any conventional spin-recovery technique results in a rapid stopping of the spin. Stopping the spin does, however, leave the aircraft in nearly a vertical dive since the spin is a normal nose-well-down spin. Recovery from this dive with flaps up and the loading which existed on N 819B would take from 1,000 to 1,500 ft. of altitude.

If a spin or any other maneuver is entered which endangers the safety of the aircraft during a flight test, the CAA inspector customarily takes over the controls and recovers from the maneuver. The performance of this function is possible with the single throw-over control column. However, during the entry of a spin or its recovery, particularly at low altitude, the Board believes this function would be considerably more difficult.

When N 819B contacted the ground it was in approximately a 20-deg. nose-low attitude with the left wing down and was moving slightly forward and to the right but primarily vertically downward. This indicates that a recovery had not been effected even though opposite rudder (right rudder deflection) control existed at impact. The nose-up attitude (relative to a normal spin) was in all probability caused by the pilot's last-second attempt to pull the nose up by up-elevator movement just before contacting the ground.

The Board is of the opinion that a stall and spin occurred at a low altitude during the demonstration of one of the engine-out minimum-control speed maneuvers. The Board is, however, unable to determine their reasons for entering the initial spin. Nevertheless, it believes that the following factors may have caused or contributed to the entry into the spin. The only experience that Inspector Hill had in this particular make and model aircraft was during the flight ending in the accident. During this time, about 1 hr., it is reasonable to believe that the applicant pilot did most of the flying.

It appears that the inspector was not familiar with the handling and stalling characteristics of the airplane. During the performance of simulated engine-out maneuvers at minimum-control speed it is therefore possible that the aircraft reached a stall-spin airspeed condition before the inspector recognized it. In this condition, any mistaken handling of the powerplant or flight controls could lead to an unintentional spin.

The unbuckled condition of all four safety belts was considered unusual for a flight in which stalls and other change of attitude maneuvers were to be performed. Since there appears to be no logical reason for the occupants of the front seat to unfasten their safety belts during the flight, it must be presumed that the belts became unbuckled as a result of ground impact forces.

The safety belts comply with existing standards for seat belts but these standards do not specifically require that a belt remain fastened under rebound conditions. To perform its intended function, however, a belt must maintain its integrity through any survivable impact condition. The extreme

Chinese Communists Build Version of Soviet Yak-12

Chinese Communist version of Soviet Yak-12 was built in 75 days and nights by five skilled workers, nine professors and 120 students of the School of Aeronautical Industry, Chenyang.

NOW LEASING
Last of Southern California's jet
AIRPORT
INDUSTRIAL
SITES

40 minutes from downtown Los Angeles

Ontario International Airport now offers choice single or multiple-acre sites adjacent to runways for long-term lease.

- **Fog-free progressive jet airport served by 3 airlines, 3 transcontinental railroads.**
- **Strategically located on Los Angeles freeway system.**
- **Ideal residential, recreational and cultural facilities.**
- **Ample labor force and utilities.**
- **Airport neighbors include General Electric, Lockheed Service Corp., and Aerojet-General Corp.**

Act today. Write for complete details to:

Ontario MUNICIPALLY OWNED
INTERNATIONAL AIRPORT

Tom Flaherty, Mgr. • YUkon 6-6123
Ontario, California

ground forces to which the occupants of N 819B were subjected were primarily downward into the seat and precluded survival even if the buckles had remained closed.

The Board concludes that a factor in this accident may have been Inspector Hill's unfamiliarity with the Beech Model 95.

Civil Air Regulations permit the use of the throw-over control wheel for type rating flight checks in lieu of fully functioning dual controls when the Administrator has determined that fully functioning dual controls are not necessary.

This determination is made by CAA inspectors when and after considering all factors, they are satisfied that the test can be conducted safely.

The Board is of the opinion that in a flight check with this type aircraft a spin should not normally occur but that if a spin is inadvertently entered, recovery may be effected with a throw-over wheel positioned on either side of the cockpit provided there is sufficient altitude. However, the Board is of the opinion that on this particular flight fully functioning dual controls might have prevented the accident.

Aviation Safety Release No. 405 was issued in June, 1956, to combat a rising accident rate in light twin-engine aircraft operating on one engine. The release directed that an increased emphasis be placed on engine-out procedures and that examiners require that the applicants demonstrate satisfactory competence in flying the aircraft under these conditions. After the release of ASR 405 the accident rate trend reversed and has shown a steady decrease, attesting to the merit of this release.

The Board recognizes that the proper demonstration of single-engine maneuvers necessitates the aircraft being flown at airspeeds bordering stall conditions. The Board recognizes also that there are advantages in performing the maneuvers as low as possible to most nearly simulate control and power conditions of an engine failure in the critical circumstance of takeoff and landing.

Following the accident, the CAA instructed its flight inspector and examiner personnel to provide, during flight tests in multi-engine aircraft, sufficient altitude for safe recovery from inadvertent spins occurring during maneuvers conducted at minimum-control speeds, engine out.

PROBABLE CAUSE

The Board determines that the probable cause of this accident was the unintentional entry into a spin at too low an altitude to recover.

By the Civil Aeronautics Board:

James R. Durfee
Chan Gurney
Harmar D. Denny
G. Joseph Minetti
Louis J. Hector

The Civil Aeronautics Board was notified of this accident at 1605 EST, July 22, 1958. Although this accident is in the category the Board authorized CAA to investigate, under delegation of authority contained in Public Notice PN-7, the CAA requested that the Board assume responsibility for the investigation inasmuch as a relatively new model aircraft was involved. On July 23, 1958, the Board terminated that delegation as requested by the CAA, and directed that an investigation be made by the Board in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. Investigation was immediately initiated and a public hearing was held by the Board in Little Rock, Ark., on Aug. 26-27, 1958.

N 819B Beech Model 95, was manufactured on May 7, 1958, with serial No. TD-117. The aircraft was bought from Beech Aircraft Co. on May 10, 1958, by Central Flying Service, Inc., at Little Rock, Ark. Total aircraft time at date of accident was 87:02 hr.

Lycoming model 0-360-A7A engines equipped with Hartzell model HC922K-2 propellers were installed in the aircraft. Time on each of the engines and propellers totaled approximately 87 hr. since new.

James H. McClellan, age 31, held airman certificate No. 1208765 with commercial pilot and airplane single-engine land ratings. His last second-class CAA medical examination was taken on July 22, 1958. He had a total flying time of 1,500 hr., of which five hours were in the subject aircraft, and a total of 10 hr. in this airplane class.

Willis D. Hill, age 57, held airman certificate No. 63925 with airline transport, multi-engine land and flight instructor ratings. He had logged a total of 5,341 flying hours, of which approximately 70 were in light twin-engine aircraft. His last CAA medical examination was accomplished Aug. 1, 1957. His medical certificate showed a Class I lens restriction and a waiver for wearing lenses issued in 1948.

Acoustics Engineers

Our recently established acoustics laboratory offers ground floor opportunities to qualified acoustic engineers. Facilities men with experience in measuring and testing high intensity levels, analytical engineers capable of predicting spectrum of noise from various sources, and structural dynamicists able to predict sonic effects on missiles and aircraft are all needed immediately.

Analog Computers—Our RADAC (Research and Development Analog Computer) laboratory has recently been expanded to a 300 amplifier facility. This group has openings for mathematicians and engineers capable of programming and solving problems of missile and aircraft design arising from all engineering groups. IBM 704 computer available to augment analog equipment.

Qualified engineers are invited to send resume to:

H. Keever
Engineering Personnel Manager, Box AW-129
North American Aviation, Inc.
Columbus, Ohio

THE COLUMBUS DIVISION OF
NORTH AMERICAN AVIATION, INC.
Home of the T2J Jet Trainer and the A3J Vigilante

WHO'S WHERE

(*Continued from page 23*)

Changes

John Gustavson, senior engineer, Advanced Planning Division for Space Propulsion, Grand Central Rocket Co., Redlands, Calif. Also: **Frederick F. Harris**, director of the company's Quality Control Division.

Roy Smelt, manager-Discoverer satellite project, Lockheed Missiles and Space Division, Sunnyvale, Calif.

Richard H. Johns, industrial products marketing manager, Autonetics, a division of North American Aviation, Inc., Los Angeles, Calif.

Herbert W. O'Farrell, superintendent of manufacturing engineering, Summers Gyroscope Co., Santa Monica, Calif.

Joseph A. Ackermann, sales manager, Elwell-Parker Electric Co., Cleveland, Ohio. **John A. Draxler** succeeds Mr. Ackermann as chief engineer.

Joseph Statsinger, director of engineering, Servo Corporation of America, New Hyde Park, N. Y.

J. M. Gruitch, director of government products, ACF Industries, Inc., New York, N. Y.

Andrew J. Unetic, manager, Bourns Instrument Division, Bourns Laboratories, Inc., Riverside, Calif.

E. I. Bricker, division engineer, Engineering Research Laboratories, Georgia Division, Lockheed Aircraft Corp., Marietta, Ga. Also: **John L. Stoddard**, head of Lockheed-Georgia's newly created Spares Organization. **Tom Cleland** succeeds Mr. Stoddard as field service manager.

General Electric Co. has combined its Technical Products Department, Syracuse, N. Y., and its Communication Products Department, Lynchburg, Va., and named **Harrison Van Aken** as general manager of the consolidated operation, known as General Electric Communication Products Department, with headquarters in Lynchburg.

Lt. Cmdr. Sam B. Arnold (USN, ret.), assistant to the director of sales and administration, Technical Products Division, Packard Bell Electronics Corp., Los Angeles, Calif.

Kenneth F. Miller, head of the newly established Military Electronics Department, Systems Division, Beckman Instruments, Inc., Anaheim, Calif.

Dr. Thomas J. Carroll has joined the Advanced Development Staff, Government Products Group, Radio Division of Bendix Aviation Corp., Baltimore, Md.

James J. Carlin, production engineer, Viltors, Inc., Port Washington, N. Y.

Dr. Fernando Cruz, general manager, LACSA Airlines.

Louis Bradley, chief of the laboratory division-engineering department, Astrionics Division, Fairchild Engine and Airplane Corp., Wyandanch, N. Y.

Thomas Bannon, director of production engineering, Clearing, Division of U. S. Industries, Inc., Chicago, Ill. Also: **John Cameron**, assistant chief engineer-technical services.

Robert H. Shatz, chief-technical military planning, Missiles & Space Systems Division, United Aircraft Corp., East Hartford, Conn.

EXPANDED RESEARCH

to advance new concepts of SPACE FLIGHT

Expanded Research programs to meet the most complex technological requirements of the Space Age are only one of the far-reaching objectives of the new multi-million-dollar Lockheed Research Center, near Los Angeles. Destined to become one of the nation's major research installations, its programs are broad in scope and designed to investigate new frontiers of space flight.

A primary consideration in planning the new Research Center was to provide environment for scientific freedom and ideal research conditions—using the most advanced equipment available. This modern, integrated research facility will touch almost every aspect of aviation and transportation—leading toward exploration into completely new or relatively undeveloped fields of science and industry.

On completion, most of Lockheed's California Division's research facilities will be located in this single area. The Center will provide complete research facilities in all fields related to both atmospheric and space flight—including propulsion, physiology, aerodynamics and space dynamics; advanced electronics in microwave propagation and infrared; acoustics; mechanical and chemical engineering and plasma/magnetohydrodynamics; thermal electricity; optics; data communications; test and servo-mechanisms.

The first phase of the advanced research building program has already begun—with initial construction of a $5,000,000 supersonic wind tunnel and high-altitude environmental test facilities.

Scientists and engineers of high caliber are invited to take advantage of outstanding career opportunities in this new Lockheed Research Center. Openings now exist for thoroughly qualified personnel in: Electronics; aero and thermo dynamics; propulsion; servo-mechanisms; materials and processes; structures and stress; operations research; research in optics, infrared, acoustics, magnetohydrodynamics, instrumentation, mechanics and hydraulics; mathematics and in all phases of design.

Write today to: Mr. E. W. Des Lauriers, Manager Professional Placement Staff, Dept. 11043, 1708 Empire Avenue, Burbank, California.

LOCKHEED

CALIFORNIA DIVISION

BURBANK, CALIFORNIA

EMPLOYMENT OPPORTUNITIES

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

Positions Vacant	Civil Service Opportunities	Employment Agencies
Positions Wanted	Selling Opportunities Wanted	Employment Services
Part Time Work	Selling Opportunities Offered	Labor Bureaus

DISPLAYED ——**RATES**—— **UNDISPLAYED**

The advertising rate is $45.00 per inch for all advertising appearing on other than a contract basis. Frequency rates quoted on request.

An Advertising inch is measured ⅞" vertically on a column—3 columns—30 inches to a page.

Subject to Agency Commission.

$2.70 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.

Position Wanted Ads are ½ of above rate.

Box Numbers—counts as 1 line.

Discount of 10% if full payment is made in advance for 4 consecutive insertions.

Not subject to Agency Commission.

Send NEW ADS to Classified Advertising Div. of AVIATION WEEK, P. O. Box 12, N. Y. 36, N. Y.

PERFORMANCE ENGINEERS

AIRCRAFT & SPACE VEHICLE SYSTEMS EVALUATION

Diversified projects include the evaluation of advanced propulsion concepts for subsonic, hypersonic, and space vehicles in terms of system performance capabilities.

Sustained program with excellent management support—digital computer services—and contributing efforts by experienced component specialists.

Minimum qualifications for these positions include a B. S. degree in aeronautical engineering plus three years' related experience.

For information write to

Mr. J. A. Farrell

RESEARCH DEPARTMENT

UNITED AIRCRAFT CORPORATION

400 Main Street **East Hartford 8, Conn.**

DISTRIBUTORSHIP

Canadian manufacturer seeks reliable progressive American company or sales engineer with proven sales record to market aircraft test equipment in United States. Replies confidential to Aviation Week

RW-1427, Aviation Week
Class. Adv. Div., P. O. Box 12, N. Y. 36, N. Y.

What is *your* problem?

Competent men for your staff? . . . employment? . . . or are you looking for—or offering—a business opportunity of special interest to readers of this publication? You can get their attention—at small cost—through an advertisement in the Employment Section of AVIATION WEEK.

POSITIONS VACANT

Flight Instructors—Age 26-38 with commercial, instructor and instrument ratings. Minimum 2000 hours or previous military pilot rating. Ground School Instructor to teach aircraft engineering. Teaching experience and knowledge of aircraft engines required. B. S. degree in education preferred. Air Force flight training school, many fringe benefits; housing available. Contact Personnel Manager Anderson Air Activities, Malden Air Base, Missouri.

Aircraft—Sales Manager. Leading Aviation Export Firm with warehouses New York and overseas seeks V. P. to develop sales of surplus transport aircraft to airlines and air forces. Unusual opportunity. P-1483, Aviation Week.

Ground School Instructor is needed by Allegheny Airlines, Inc., to work in Washington, D. C. Applicant must be able to teach on all equipment and ground school and able to operate the link—maintain records and manuals. Write Personnel Office, Hangar 12, WNA, Washington, D. C.

Aircraft Mechanics — immediate openings with certified airlines and private firms for qualified Aircraft Sheet Metal Men, Aircraft Electricians, Aircraft Electronic Men and A & Es with CAA licenses. Current assignments in all parts of the US and throughout the world. Some positions include scheduled overtime, per diem allowances and/or overseas bonuses. Regional interviews arranged. Write in confidence to John Reed, Fidelity Personnel Service, 1218 Chestnut Street, Philadelphia 7, Penna.

POSITIONS WANTED

Company Executive-Experienced helicopter operations both domestic and foreign. Scheduled, non-sked and "Bush" operations. Interested in joining newly formed company or forming same with suitable individuals. 14 years flying. Outstanding references and proven background. Confidences respected. Reply PW-1315, Aviation Week.

Challenging South American assignment and/ or flying position desired. Airline Transport Pilot, 7900 hours, DC-3, DC-4, DC-6, CV 340, light twins. Age 31. Excellent Spanish. PW-1282, Aviation Week.

Twenty years Maintenance and Supervisory experience on all types of aircraft. Last ten on DC 6, DC 7, 707. Not an engineer but can coordinate engineering and operational problems. Familiar with maintenance procedures and standards, parts procurement airline operations AMP, AMP instructor, private Lic. 38, married, 3 children. PW-1454, Aviation Week.

Commercial with ATR ratings on Constellation, DC-4, DC-3, B26 & Lodestar. Total time 13,726 hrs. with 690 jet. Will travel anywhere, prefer west coast. PW-1477, Aviation Week.

SELLING OPPORTUNITY WANTED

Mfg's Agent—Graduate EE desires to represent quality electronic systems and component lines—Govt. R&D experience—adequate capitalization. Southwestern U.S. El Paso, Texas. RA-1335, Aviation Week.

FOR SALE

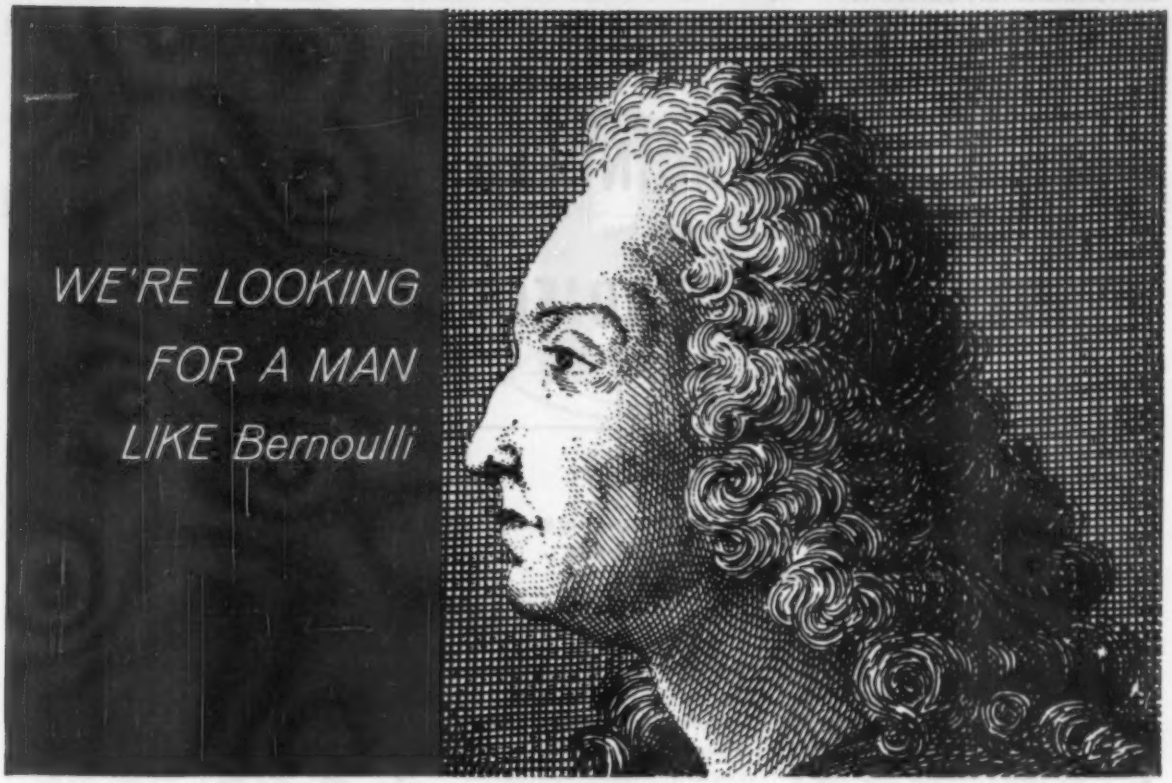
PBY Amphibian Aircraft. . . . . Surplus to Canadian Exploration Company's requirements. Extra large cargo doors and Flooring. Airline compartment seat 8. Galley facilities. Aircraft licensed for full IFR operation. Includes JATO. Write for specifications on other PBY's and details of conversion to EMQ Super Catalina meeting 04B requirements. . . . . No reasonable offer refused. Timmins Aviation Limited, Montreal Airport, Montreal.

DeHavilland Heron. . . . . A low time airplane operated by a leading Canadian Corporation and maintained in excellent condition throughout. Only 375 hours since major overhaul on airframe and engines. Completely equipped for all weather flight, including Collins IFS. Janitrol Heat. Luxurious accommodations for 8 passengers. . . . . No reasonable offer refused. Timmins Aviation Limited, Montreal Airport, Montreal.

WANTED

Wanted—Two R-2000 Engines 1450 H.P. Run Outs—Without failure write or cable giving full particulars to Ladeco—Amunategui 73, Santiago—Chile, S. A.

Wanted—Two Wright R1820-76A or B Engines suitable for overhaul. Give details, price, serial numbers. Total time and time since overhaul. W-1459, Aviation Week.



$$P_2v_1 + h_2d_2v_1g + \tfrac{1}{2}d_2v_1V_2^2 = P_1v_1 + h_1d_1v_1g + \tfrac{1}{2}d_1v_1V_1^2$$

—WITH A MODERN TURN OF MIND

Bernoulli pushed through the first frontier of hydrodynamics.

Today the underwater-to-air-to-underwater SUBROC antisubmarine missile is being developed at Goodyear Aircraft.

If you have a Bernoullian bent, this program will appeal to you—and so will the company—the people and the organization.

*So, too, will rock-solid programs in astronautics—already underway at Goodyear Aircraft—destined to throw light on the dark side of the moon.**

If you're good, we'll sign you in. If we sign you in, you won't want to leave—for reasons as sound as your future. And ours.

Write: Mr. Charles Jones, Director of Technical & Scientific Personnel, Goodyear Aircraft Corporation, Akron 15, Ohio.

GOODYEAR AIRCRAFT

* Programs in rocket propulsion, interplanetary guidance, nose cones, advanced black boxes, crew-escape capsules—also in ground support systems for missiles, radar structures, radomes, radiation research, structures engineering.

HIGH-LEVEL ENGINEERS

to work on exciting new

ANTI-MISSILE PROJECT

in sunny San Diego

Brilliant ground-floor opportunities in the fields of:

FLUID SCIENCES **FLIGHT MECHANICS**
DYNAMICS **STRUCTURES**
AIRBORNE RADAR SYSTEMS

Solar's new ARPA Project involves a completely new system of anti-missile defense. It is the latest of several highly advanced projects of Solar's Missile and Space Group. The right men joining now will get in on the ground floor and gain key creative positions in their fields of interest. It will be to your advantage to learn complete details immediately.

SOLAR SPECIFICS

Solar is a medium-size company (2500 people in San Diego) with a successful history since 1927. It is big enough to offer the most advanced personnel policies, yet small enough so you don't get lost in the crowd. Salary and performance reviewed semi-annually. Liberal relocation allowances. Solar is making many significant contributions to space-age technology, and the special professional status of engineers is fully appreciated and recognized. A new 60,000 sq. ft. engineering building, necessitated by expanding research and development, will be completed in 1959 on the edge of San Diego Bay.

SEND RESUME

Please send resume of your qualifications at the earliest opportunity to Louis Klein, Dept. E-354, Solar Aircraft Company, 2200 Pacific Highway, San Diego 12, Calif.

SOLAR
AIRCRAFT COMPANY
SAN DIEGO
DES MOINES

LIVE BETTER, TOO! In addition to greater opportunities for personal achievement, Solar also offers you the chance to live better in sunny San Diego. This famous resort area has the finest year-around climate in the U.S. Cultural, educational and recreational facilities are excellent. The new Advanced Sciences Branch of the University of California offers facilities for further study. You and your family will enjoy life more at Solar in San Diego.

ENGINEERS:

The kind of work you want in MISSILE ELECTRONICS

The kind of life you want for your family

GET *BOTH* AT

BENDIX YORK

ELECTRONIC ENGINEERS

PHYSICISTS

MECHANICAL ENGINEERS

• Challenging opportunities in CIRCUIT DESIGN, PULSE & VIDEO CIRCUITRY, MICROWAVE, DIGITAL & ANALOG COMPUTERS, SEMI-CONDUCTORS, COMPONENT AND CIRCUIT RELIABILITY.

Interesting work on FUZING TECHNIQUES, BEACONS, SIMULATORS, SPECIAL TEST EQUIPMENT.

• Bendix York offers you the opportunity for rapid professional growth and advancement. Enjoy the small-company atmosphere of an expanding division of one of America's largest engineering and manufacturing corporations . . . And the way of life in and around York, Pennsylvania is ideal for the entire family. It combines the charm and grace of rural living with the many advantages of a dynamic and progressive community.

Let us hear from you!
Address replies to: Dept A
PROFESSIONAL EMPLOYMENT

Bendix
AVIATION CORPORATION
York Division
York, Pennsylvania

"The way of work for you, the way of life for your family!"

Engineers – Scientists Required for many aspects of General Electric's Aircraft Nuclear Propulsion Program...

APPLIED RESEARCH & DEVELOPMENT AT THE PhD LEVEL ON AN INTER-DISCIPLINARY BASIS

Opportunities now exist for a number of scientists and engineers with imaginative minds and established reputations to contribute to extremely sophisticated nuclear propulsion systems, where theoretical advances must be wedded to new standards of reliability and performance.

Qualified engineers and scientists are invited to inquire about these opportunities to pursue original work in a pioneering area with General Electric.

Write in confidence, including salary requirements, to:
Mr. G. W. Travers, Div. 64-WP

AIRCRAFT NUCLEAR PROPULSION DEPT.

GENERAL ELECTRIC

P.O. Box 132 Cincinnati 15, Ohio

Metallurgy	Advise Materials Testing Laboratory on materials problems and techniques. Direct experimental, physical, mechanical and electrical tests. Analyze data.
Physics or Nuclear Engineering	Carry out reactor analysis and nuclear design of power plants, including formulation of nuclear design specifications and test requirements.
Ceramics, Physical Chemistry or Ceramic Engineering	Supervise applied ceramic research including fabrication processes, testing of ceramic bodies; development of novel ceramic materials.
Physics	Conduct theoretical investigations of effect of neutrons and photons on matter.
Mathematics, Electrical Engineering	Engineering analysis of physical systems in electro-mechanical areas, deriving equations associated with systems study. Develop generalized digital program for parametric study of these systems.
Mathematics	Apply advanced mathematical procedures and approaches in resolving complex problems in areas of reactor analysis.
Physics or Nuclear Engineering	Advanced Reactor Analysis. Plan objectives of experimental reactor investigations, which adequately combine potentialities of experimental techniques and improvement of theoretical methods.
Physical Metallurgy or Mechanical Engineering	Undertake responsibility for studies regarding various materials used in moderator materials development.
Nuclear Engineering	Plan, design and analyze specific nuclear shield tests – part of broad nuclear shield design program.
Physics	Participate in shield physics experiments, to provide fundamental data for shield design.

A number of additional positions in areas described above are also available to candidates with a Master's Degree.

ENGINEERS

ERCO

a pioneer and one of the leading producers of electronic flight simulators, is increasing its engineering activity to include volume engineering programs in the fields of analog and digital computer techniques, telemetry, transistor applications and light/optical scanners.

Challenging and diversified assignments in Product Design are offered by this constantly growing organization to the career-minded engineer who wishes to combine stability with the latitude necessary for rapid professional and financial growth. Immediate opening exists for qualified, professional personnel whose areas of experience coincide with the following requirements:

CIRCUIT DESIGN JUNIORS, INTERMEDIAATE AND SENIOR, B S E E for transistor circuitry, application, analog and digital computer techniques, DC amplifiers, simulation, telemetry and design of systems and components.
B S in physics, plus experience in one or more of the following: optics, hydraulic instrumentation, human engineering, numerical analysis, computer techniques.

HUMAN FACTORS PhD degree in experimental, physiological or industrial psychology with 3 to 5 years' industrial experience as engineering psychologist or comparable years of experience with military as training and/or proficiency measurement specialist. Will head 3-man team conducting plant-wide human factors efforts, including human engineering of high-fidelity weapon system simulators and trainers.

TECHNICAL WRITERS B S in E E or Physics, or equivalent, plus 2 years' experience in the preparation of operational and maintenance manuals & engineering reports concerning electronic systems & components.

EXCELLENT SALARIES
Commensurate with Education and Experience
MODERN COMPANY BENEFITS
Including Educational Assistance Plan
RELOCATION ASSISTANCE
IDEAL LIVING CONDITIONS in suburban Washington, D. C.

Send resume To: Mr. R. J. Reid, Technical Employment Manager

ERCO PLANT

NUCLEAR PRODUCTS—ERCO
DIVISION OF ACF INDUSTRIES INCORPORATED
RIVERDALE, MARYLAND, WARFIELD 7-4444

FLIGHT PROPULSION

Major company, expanding its activities to include the design, development and production of every type of power plant for present and future flight propulsion systems, has urgent need for engineers and scientists in the following areas:—

Aerodynamics • Metallurgy
Weldments • Ceramics • Chemicals
Nucleonics • Thermodynamics
Mathematics • Instrumentation
Test & Facilities • Field Engineering

Salary range $8,000-$18,000.

These positions are fee paid, include complete relocation expenses and offer liberal company benefits. Direct interviews with our client will be arranged in your area without delay! Send resume in duplicate, for confidential consideration, to—

Fidelity Personnel Service
1218 Chestnut St., Philadelphia 7, Penna.

SALES EXECUTIVE

Rapidly expanding aircraft and missile instrument manufacturing firm needs successful man to direct sales program. Liberal stock option plan.

Washington Machine & Tool Works, Inc.
Minneapolis 40, Minnesota.

NEED ENGINEERS?

An employment advertisement in the EMPLOYMENT OPPORTUNITIES SECTION will help you find the engineers you need. It's an inexpensive, time-saving method of contacting competent personnel for every engineering job in the Aviation industry. The all paid circulation of AVIATION WEEK offers you an opportunity to choose the best qualified men available.

For additional information write: Classified Advertising Division

AVIATION WEEK, P.O. Box 12, New York 36, N.Y.

New "EMPLOYMENT" Advertisements

received by 10 A.M. April 24 will appear in the May 11 issue, subject to space limitations.

AVIATION WEEK
Classified Advertising Division
P. O. BOX 12
NEW YORK 36, N. Y.

Professional Personnel Requisition

Controls & Instrumentation Engineers

Marquardt Aircraft — a leader in air and space propulsion and control systems, high altitude rocket research and weapon support systems — offers a creative engineering environment in which you will find significant active projects. These include engine control systems for nuclear turbojet, inlet control systems for the North American F-108 and Hound Dog missile, control systems for the supersonic ramjet engine, feasibility studies of advanced and unique engine cycles, nozzle control for advanced ballistic missile components and other power system actuators. These control units include fluid and gas operated servo systems suited for environments above one thousand degrees.

If you are an engineer experienced in fluid dynamics or fluid operated controls and interested in mechanisms designed for severe environmental conditions, you should consider one of the following engineering opportunities at Marquardt:

CONTROLS DESIGN

To create components for pneumatic and hydraulic control systems. Work ranges from simple piston actuators to complex speed computing devices. All designed for high sensitivity, fast response, extreme environmental conditions and light weight. Should be experienced in machine design and have an understanding of basic design analysis.

CONTROLS ANALYSIS

To investigate aircraft and missile control problems through the application of analysis methods in mechanics and dynamics, heat transfer, compressible flow, and servomechanisms. Position offers opportunity for creative engineering.

CONTROLS DEVELOPMENT

Opportunity to create workable controls components. Must have a "feel" for hardware and desire to undertake broad engineering responsibility. Opportunity to solve "on-the-spot" engineering problems utilizing pneumatic and hydraulic control analysis techniques.

ENGINEERING STANDARDS

Implement, establish and/or originate the use of standards both design and hardware for reduction of time and cost of engineering effort. Must have knowledge of hydraulic and pneumatic design and components. Should be capable of setting up an evaluation program as required. Requires ability to work with many engineering groups both in advisory and service capacity.

CONTROL RELIABILITY

To predict reliability of control of units and recommend appropriate design changes. Knowledge of servomechanisms and feedback theory desirable. Should have background in statistics and experience in reliability field.

INSTRUMENTATION

Specification and design of instrument components and systems for ground testing of supersonic ramjet engines, jet engine components, inlet controls, nuclear powerplant controls and emergency power units. Prefer instrumentation experience, including data acquisition and processing equipment. Familiar with process control systems.

For additional information, please write

Mr. Floyd E. Hargiss, Manager
Professional Personnel, Dept. A-3
Marquardt Aircraft Co.
16555 Saticoy Street
Van Nuys, California

Marquardt AIRCRAFT CO.

VAN NUYS AND POMONA, CALIFORNIA—OGDEN, UTAH

COOPER DEVELOPMENT CORP.—MONROVIA, CALIFORNIA—A MARQUARDT SUBSIDIARY

ENGINEERS & SCIENTISTS

Join In Developing
A New Regime
Of Power Plants
AT

FLIGHT PROPULSION DIVISION

Commercial Engine Operation
Flight Propulsion Laboratory Dept.
Jet Engine Department
Production Engine Department

GENERAL ELECTRIC

Cincinnati, Ohio

Teams of engineers and scientists in our division are working on far advanced jet and rocket engines and new approaches to space propulsion.

IMMEDIATE NEEDS FOR:

VIBRATION/MECHANICAL ANALYSIS: AE or ME with 2 years experience in applied mechanics, to establish experimental programs for development engines.

CYCLE ANALYSIS: ME with 4 years experience in thermo design, for cycle analysis programs to improve development engines and predict the effect of modifications and performance of "paper" engines.

COMBUSTION ENGINEER: ME with 2 years development experience for J93 Project (powering the B-70).

CONTROL MECHANICAL DESIGN: ME with 3-5 years experience to design hydraulic or hydromechanical controls for jet and rocket engines.

MECHANICAL DESIGN RELIABILITY: ME or AE with 3 years gas turbine experience, to review designs for reliability and carry out reliability program for development engines.

SCIENTISTS: MS or PhD and related experience for major programs in plasma jet, ion propulsion, other advanced concept programs.

MAIL YOUR RESUME OR THIS COUPON TO THE ADDRESS BELOW:

Mr. Mark Peters
Bldg. 100, Dept. 64-WP
Flight Propulsion Division
General Electric Company
Cincinnati 15, Ohio

I want to learn more about FPD research and engineering. Please send "Thrust & Progress" brochure.

NAME .....

ADDRESS .....

.....

.....DEGREE .....YEAR.....

ENGINEERS AND SCIENTISTS

Here is your opportunity to grow with a young, expanding subsidiary of the Ford Motor Company. Outstanding career opportunities are open in Aeronutronic's new RESEARCH CENTER, overlooking the Pacific at Newport Beach, and the facility in Glendale, California. You will have all the advantages of a stimulating mental environment, working with advanced equipment in a new facility, located where you can enjoy California living at its finest.

PhD and MS RESEARCH SPECIALISTS with 5 to 7 years' experience in heat transfer, fluid mechanics, thermodynamics, combustion and chemical kinetics, and thermoelasticity. To work on theoretical and experimental programs related to re-entry technology and advanced rocket propulsion. Specific assignments are open in re-entry body design, high temperature materials studies, boundary layer heat transfer with chemical reaction, thermal stress analysis, and high temperature thermodynamics.

PROPULSION ENGINEERS with 5 years' experience in liquid and solid rocket design and test. Familiarity with heat transfer problems in engines desirable. To work on program of wide scope in R & D of advanced concepts in rocket engine components, and for missile project work.

APPLIED MATHEMATICIANS. 3-5 years recent experience required and A.B. or M.A. degree. Experience in numerical analysis and computer work in connection with rockets and rocket propellants.

STRESS HIGH TEMPERATURE MATERIALS. Mechanical or Metallurgical Engineer, must be familiar with thermal stress and shock as well as elasticity and plasticity. Application to nose cones and thrust chambers.

FLIGHT TEST & INSTRUMENTATION ENGINEERS with 5 to 10 years' experience in laboratory and flight test instrumentation techniques. Will develop techniques utilizing advanced instrumentation associated with space vehicles.

THEORETICAL AEROTHERMODYNAMICIST. Advanced degree and at least 5 years' experience in high-speed aerodynamics. Knowledge of viscid and inviscid gas flows required. To work on program leading to advanced missile configurations. Work involves analysis of the re-entry of hypersonic missiles and space craft for determining optimum configuration.

CERAMIST, M.S. or Ph.D. required and 3-5 years recent experience with high temperature materials, structures and cermets.

ENGINEER or PHYSICIST. With experience in the use of scientific instruments for making physical measurement. Work related to flight test and facility instrumentation. Advanced degree desired with minimum of 3 years of related experience.

Qualified applicants are invited to send resumes and inquiries to Mr. R. W. Speich, Aeronutronic Systems, Inc.

SPACE TECHNOLOGY DIV.

AERONUTRONIC

a subsidiary of Ford Motor Company

Bldg. 12, P.O. Box 697, Newport Beach, Calif.

Newport Beach, Glendale, Santa Ana, and Maywood, California

WHERE TO BUY

Featuring additional products, specialties & services for the aviation field

NEW! STARTLING!

Scientific Break-thru. Acclaimed by Space Experts as the Most Comprehensive Visual Tracking Aid ever devised to show you How, When and Where to look for Satellites . . . beautifully illustrated in Full Color. Easy to use . . . Simple to understand. Now! Only $2.00 Postpaid . . . . . Anywhere!

RESEARCH PUBLICATIONS, INC.
1687 Laurel, San Carlos, Calif.

Enclosed $..... Please send me.....
Satellite Trackers Postpaid to:
Name .....
Address .....
City..... State.....
Dept. AW-420 Satisfaction Guaranteed!

Cinefonics Inc.

Specialists in the production of
MOTION PICTURES
for R&D contracts, Table 210 requirements, capabilities, achievements and products

A UNIQUE SERVICE COMBINING ENGINEERING AND FILM TALENT

6401 Oakton Street Morton Grove, Illinois
Phone: Niles 7-6600
TWX: Niles ILL 2270 or 2271

AIRCRAFT & MISSILE STAINLESS STEEL TUBING

. . . for immediate delivery from 3 strategic locations.

A. B. MURRAY CO. INC.
EST. 1845
Elizabeth, N. J. • Bristol, Pa. • McKeesport, Pa.

GPL

field representatives are the

happiest

proudest

best rewarded

field representatives in this or any other country

If you have experience with analogy computers and radar systems, are free to relocate to Air Force or air-frame manufacturers' bases, and would like to work on the most accurate self-contained airborne navigation systems available,

OR

If you have experience with digital computers and would like to work on this country's air traffic control system at airports throughout the country,

THEN

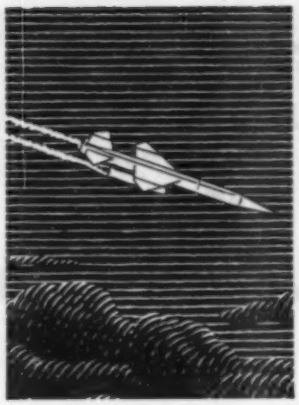
We would like to meet you and discuss how you might become a happy, proud, and well - rewarded GPL field representative.

Openings also exist for recent college graduates (EE's or Physicists). A 12-week training program will be conducted in Pleasantville prior to assignment.

Contact: William I. Schell
GENERAL PRECISION LABORATORY
INCORPORATED
63 BEDFORD RD., PLEASANTVILLE, N.Y.

GPL | A GENERAL PRECISION COMPANY

A Subsidiary of General Precision Equipment Corp.



SENIOR INDUSTRIAL ENGINEERS

Expanding jet aircraft and advanced missile programs at Boeing have created a number of outstanding career opportunities for Senior Industrial Engineers. These are rewarding, long-range openings, with plenty of opportunity for advancement.

Assignments include schedule planning, methods analysis, and research in connection with operations and systems and other areas associated with industrial engineering activities.

Requirements: a degree in one of the engineering sciences, preferably a Bachelor of Science in EE, ME or CE. Experience in methods, time study, production scheduling, machine tooling, statistics, long-range planning, operations research and other phases of engineering is desirable.

At Boeing, you'll work with the most advanced methods, materials and techniques in the industry...in a forward-striding environment that's conducive to rapid advancement.

For full details, write: Mr. Stanley M. Little, Boeing Airplane Company, P.O. Box 3822-AVG, Seattle 24, Washington.

BOEING

GPL

instructors are the happiest

proudest

best rewarded

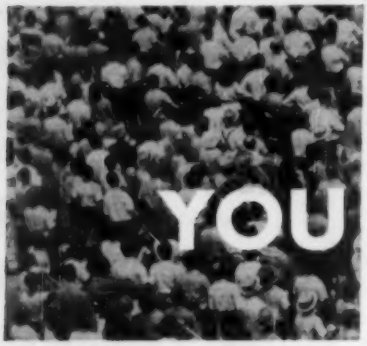
instructors in this or any other country

Our Field Service Department has openings in the home office (Pleasantville, N. Y.) for instructors having experience with either digital computers, to instruct field personnel concerning our air traffic control devices, or with analog computers and radar, for our self-contained Doppler airborne navigation systems. If you qualify, we would like to meet you and discuss how you might become a happy, proud, and well-rewarded GPL instructor.

Contact: William I. Schell
GENERAL PRECISION LABORATORY
INCORPORATED
63 BEDFORD RD., PLEASANTVILLE, N.Y.

GPL | A GENERAL PRECISION COMPANY

A Subsidiary of General Precision Equipment Corp.



ENGINEERS

Junior • Senior Project

YOU won't get lost at LEAR

Lear offers unlimited opportunities for advancement and greater responsibilities to creative minded, electronic engineers because . . .

You aren't submerged in a "chain of command." You are in direct contact with the decision makers.

Lear, for twenty-eight years a pioneer in precision flight equipment, is moving ahead in many new fields. Investment companies recognize Lear as a prime "growth" company.

If you are experienced in the design and development of air and/or ground based communication and navigation equipment, you can look for immediate recognition.

If you would like to work in sunny Southern California (just minutes from world famous Santa Monica beaches); write to:

L. S. PECK, *Manager*
Industrial Relations

LEAR INC., Dept. AW-4
3171 South Bundy Drive, Santa Monica, Calif.

At Your BUSINESS Service.

The Classified Advertising Sections (Searchlight Sections) of McGraw-Hill publications are at your service for the satisfying of almost every business need or want.

Because these publications are specialized in the field that they cover, your classified advertising of used or surplus new equipment, of securing a position of personnel, of offering or securing business opportunities will reach the right men, quickly and economically.

Classified Advertising Division

McGraw-Hill Publications, Inc.
P. O. Box 12, New York 36, N. Y.

SEARCHLIGHT SECTION

FOR SALE

GRUMMAN MALLARD

Executive Aircraft

Always received best in maintenance. Interior recently refinished. 3500 hours total A.F. time. Right engine 0 S.O.H. Left engine 650 hrs. S.O.H. Good radio. Two spare engines. One spare propeller. plus numerous other spares.

Deal directly with owner. Write

FS-1414, Aviation Week
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

DC3-C47 AIRCRAFT FOR SALE

We offer, buyer's selection 1 to 5 units of our DC3-C47 fleet of 15 aircraft, excellent condition. Potential buyers please write or cable for detailed specifications.

AEROVIAS VENEZOLANAS, S.A.
Apartado 943, Caracas, Venezuela
Cable address: Avensa, Caracas

FOR SALE

High Altitude Aircraft

FOUR LOCKHEED P-38's

Altitude Capabilities to 40,000 Feet

Aircraft have modified nose section suited for technician and instruments. Ideal for economic high altitude testing. Operating costs are diminutive compared to that of jet aircraft. Reasonably priced.

Write or Wire:

HYCON MFG. COMPANY
1030 South Arroyo Parkway
Pasadena, California

Immediate Delivery

We stock, overhaul, and install

PRATT & WHITNEY	WRIGHT
R1830	R1820
-75, -92, -94	-202, -5, -72

R985 R1340 R2000

and our most popular DC3 engine
R1830 - SUPER - 92

ENGINE WORKS INC.

Lambert Field Inc. St. Louis, Mo.

HILLER HELICOPTER

Modernized UH12B with complete agricultural spray equipment. *Very low terms*

EAST COAST AVIATION CORPORATION
Lexington 73, Massachusetts

"Save . . . On PNEUMATIC Tools"

Chicago Pneumatic 450 E.A. Electronic Dimpler-Riveter, 36" Reach, like new.

- Giant Stock-Guns
- Huck Blind Riveters
- Squeezers
- Screwdrivers, etc.
- Drills

Sales, repairs, trades, rentals.

U. S. AIR TOOL CO. Box 228
Elmont, L. I., N. Y. CUrtiss 5-4626

WANTED DC-3 or C-54

Corporation wants executive DC-3 P & W fully equipped or DC-4. Send complete details. Principals only.

W-1461, Aviation Week
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

FOR SALE

DOUGLAS DC-4Bs.

Former United Airliners

Priced for quick sale.

Call or write Madden & Playford Aircraft Inc.
P. O. Box 186 Miami 48, Fla.
Tel. TUxedo 7-9521

ADVERTISERS IN THIS ISSUE

AVIATION WEEK, APRIL 20, 1959

ACOUSTICA ASSOCIATES, INC. 60
Agency—Freedman & Ross, Inc.
AEROJET—GENERAL CORPORATION 17
Agency—D'Arcy Adv. Company
AEROQUIP CORPORATION 99
Agency—The Fred M. Randall Company
AERO SUPPLY MFG. CO., INC. 107
Agency—John Harder Fenstermacher Adv.
AIRBORNE ACCESSORIES CORP. 117
Agency—Gray & Rogers, Adv.
AIR PRODUCTS, INC. 38
Agency—The Aitkin-Kynett Co.
ALLEGHENY LUDLUM STEEL CORP. 106
Agency—W. S. Walker Adv., Inc.
ALVIS LTD.—LEONIDES ENGINES 80
Agency—Havas Ltd. International Adv.
ALUMINUM CO. OF AMERICA 15
Agency—Fuller, & Smith & Ross, Inc.
AMERICAN CHAIN AND CABLE, AUTOMOTIVE AND AIRCRAFT DIVISION 97
Agency—Reincke, Meyer & Finn
AMPHENOL ELECTRONICS CORPORATION 84
Agency—Burton Browne Adv.
ANSCO INDUSTRIAL X-RAY DEPT. 105
Agency—Benton & Bowles, Inc.
AVCO MANUFACTURING CORPORATION ..4th Cover
Agency—Benton & Bowles, Inc.

BENDIX PRODUCTS DIV., BENDIX AVIATION CORP. 96
Agency—MacManus, John & Adams, Inc.
BETHLEHEM STEEL COMPANY 8
Agency—Jones, Brakeley & Rockwell, Inc.
BOEING AIRPLANE COMPANY 35
Agency—Calkins & Holden, Inc.
BOSTON DIVISION OF MINNEAPOLIS-HONEYWELL 82
Agency—Louis K. Frank Co., Adv.
BOWER ROLLER BEARING DIV., FED.-MOGUL-BOWER BEARINGS, INC. 11
Agency—MacManus, John, & Adams, Inc.
BRISTOL AEROPLANE CO. LTD. 50-51
Agency—Young & Rubicam, Ltd.

CHANDLER EVANS 67
Agency—G. P. Sweet & Company, Inc.
CLIFTON PRECISION PRODUCTS CORP. ....3rd Cover
Agency—Ivey Advertising Company
COLLINS RADIO CO. 90
Agency—W. D. Lyon Co.
COLUMBUS DIVISION NORTH AMERICAN AVIATION, INC. ..... 114, 115, 1[illegible]
Agency—Batten, Barton, Durstine & Osborn, Inc.
CONVAIR—FORT WORTH 118
Agency—Glenn Adv. Inc.
CUSHMAN MOTOR WORKS, INC. 89
Agency—Ayres, Swanson & Assoc., Inc.

DETREX CHEMICAL INDUSTRIES, INC. 13
Agency—Howell & Young Adv.
DONNER SCIENTIFIC CO. 91
Agency—Bonfield Associates, Inc.

EASTERN INDUSTRIES, INC. 22
Agency—Remsen Adv., Inc.
ELECTRONIC COMMUNICATIONS, INC. 92
Agency—Alfred L. Lino & Assoc.
EDO CORPORATION 12
Agency—Davis, Parsons & Strohmeier, Inc.
ELECTRO SNAP CORP. 100-101
Agency—Stoetzel & Associates, Inc.
ERCO DIV., ACF INDUSTRIES, INC. 102
Agency—Conti Adv. Inc.

FENWAL, INC. 70
Agency—James Thomas Chirurg Company

GENERAL ELECTRIC COMPANY 59, 61, 63
Agency—G. M. Basford Company
GENERAL ELECTRIC COMPANY 68-69
Agency—G. M. Basford Co.
GENERAL ELECTRIC COMPANY (LMED) 28
Agency—DeGarmo, Inc.
GOODRICH COMPANY, THE B. F. 7
Agency—Batten, Barton, Durstine & Osborn, Inc.

HADLEY INC., B. H. 6
Agency—Jackson & Morse Adv.
HYATT BEARINGS DIVISION, GENERAL MOTORS CORPORATION 9
Agency—D. P. Brother & Company
HYDRO-AIRE, INC. 3
Agency—Gaynor & Ducas, Inc.

INTERNATIONAL BUSINESS MACHINES 119
Agency—Benton & Bowles, Inc.

KAMAN AIRCRAFT CORPORATION 110
Agency—Charles Palm & Company, Inc.
KELSEY HAYES COMPANY 16
Agency—Zimmer, Keller & Calvert, Inc.

LOCKHEED AIRCRAFT CORPORATION 123
Agency—Hal Stebbins Adv.
LORD MFG. COMPANY 14
Agency—The Jayme Organization, Inc.

M&G MFG. CO. 77
Agency—Marsteller, Rickard, Gebhardt & Reed, Inc.

MARQUARDT AIRCRAFT COMPANY 36-37
Agency—Grant Advertising Co.
MARTIN COMPANY, THE 120
Agency—Henry Quednau, Inc.
MICRO-SWITCH DIVISION OF MINNEAPOLIS-HONYWELL 38
Agency—Reincke, Meyer & Finn
McGRAW-HILL BOOK CO. 111

NORTH AMERICAN AVIATION, INC. 133
Agency—Batten, Barton, Durstine & Osborn, Inc.
NORTHROP AIRCRAFT, INC. 74
Agency—Erwin Wasey, Ruthrauff & Ryan, Inc.

ONTARIO INTERNATIONAL AIRPORT 122
Agency—The Essig Co.
OSTER MFG. COMPANY, JOHN—AVIONIC DIVISION 67
Agency—Burton Browne Adv.

PARKER AIRCRAFT CO. 79
Agency—Mark Hild Adv., Inc.

RADIATION, INC. 77
Agency—Bishopric, Green, Fleiden, Inc.
REDA PUMP CO. 75
Agency—Watt, Payne Adv., Inc.
RED BANK DIVISION—BENDIX AVIATION CORPORATION ..... 7[illegible]
Agency—MacManus, John & Adams, Inc.
RHEEM MANUFACTURING COMPANY .....2nd Cover
Agency—Getz & Sandborg, Inc.

SARGENT ENGINEERING CORPORATION 4
Agency—Darwin H. Clark Company
SENSENICH CORPORATION 78
Agency—Foltz Welsinger, Inc.
SHELL OIL COMPANY 35
Agency—J. Walter Thompson Company
SINGER MFG. CO. 10
Agency—O. S. Tyson & Co., Inc.
SINCLAIR REFINING COMPANY 52
Agency—Morey, Humm & Warwick, Inc.
STANDARD PRESSED STEEL COMPANY 112
Agency—Gray & Rogers Adv.
STAVID ENGINEERING, INC. 24
Agency—Gaynor & Ducas, Inc.
STROMBERG-CARLSON, DIV. OF GENERAL DYNAMICS CORPORATION 86-87
Agency—The Runrill Company, Inc.

TELECOMPUTING CORP. 88
Agency—Anderson-McConnell Adv., Inc.
TEMCO 108
Agency—Rodgers & Smith Adv.
THERMO ELECTRIC COMPANY, INC. 96
Agency—Fred Lange Associates, Inc.
TRANS-SONIC, INC. 5
Agency—Louis K. Frank Co.
TRANS WORLD AIRLINES, INC. 40
Agency—Foote, Cone & Belding

VICKERS, INC. DIVISION OF SPERRY RAND CORPORATION 18
Agency—Witte & Burden Adv.

WESTERN AIR LINES, INC. 46
Agency—Batten, Barton, Durstine & Osborn, Inc.

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 124-132
EQUIPMENT
(Used or Surplus New)
For Sale 132

ADVERTISERS INDEX

WHERE TO BUY
Cinetonics, Inc. 130
A. B. Murray Co. 130
Research Publications 130
Aeronutronic Systems, Inc. 130
Aerovias Venezolanas, S. A. 132
Bendix Aviation Corp., York Div. 126
Boeing Airplane Company 131
East Coast Aviation Corp. 132
Engine Works 132
Erco Plant 128
Fidelity Personnel Service 128
General Electric Company 127-130
General Precision Laboratory, Inc. 131
Hycon Manufacturing Company 132
Goodyear Aircraft Corporation 125
Lear Cal (Recruiting Div.) 124
Maddon & Playford Aircraft Inc. 132
Marquardt Aircraft Company 129
Remmert-Werner, Inc. 132
Solar Aircraft Company 126
United Aircraft Corporation 124
Washington Machine & Tool Works, Inc. 128

NEW PROGRAMS

have created

IMMEDIATE OPENINGS

for top quality engineers with experience in—

Preliminary Analysis
Aerodynamics
Flight Dynamics
Structural Dynamics
Aero-Thermodynamics
Flight Simulation
Space Communication
Space Instrumentation
Radar Systems & Techniques
Electronic Countermeasures
Guidance
Instrumentation
Electronics Test
Design
Computing
Reliability
Human Factors

Well paid jobs for qualified people.
Relocating expenses paid.
For information on these and other engineering positions, write:

B. J. Ralph, Dept. 451A
Missile Division
North American Aviation, Inc.
12214 Lakewood Blvd.
Downey, California

MISSILE DIVISION
NORTH AMERICAN AVIATION, INC.

LETTERS

Nuclear Tactics

Referring to your editorial in the Mar. 2 issue of AVIATION WEEK, I believe you missed one very important point in your dissertation regarding nuclear-powered aircraft, in that you made no mention of the havoc a few nuclear-powered aircraft would create within the air defense (coastal ADIZ) perimeters of ours or another nation's defensive "posture." I imagine a few nuclear powered aircraft patrolling the coasts of Russia, operating just far enough off shore to be radar detectable, would soon exhaust the Soviet defensive fighter force (or they exhaust ours, for that matter!)—at least such tactics would certainly scramble air to ground communications for quite a while!

Keep up the good work!

MAJOR, USAF
Dover, Del.

Altimeter Display

The tragic crash at LaGuardia—regardless of the outcome—only points up what has been obvious to the trade for some time. At the risk of being pedantic, I would like to submit my suggestion for an altimeter (see attached drawing). They (?) may have already thought of it, but then again the obvious is many times obscured by the beloved minutiae of the technician.

The only shortcoming of this arrangement would lie in the relatively constant transitioning of the digits when cruising, for instance, at 17,000 ft. in rough air. This could be alleviated by holding an altitude 100 ft. above the assigned.

Outside of a boxing glove arrangement to hit the pilot when going below minimums, I feel that it provides a more lucid presentation than any I have seen to date. It may also contain some instrumental problems but they do not appear insurmountable. Even the boxing glove is partially provided by a preset altitude selector which would energize a red light when either 100 ft. above or below the preselected altitude. This particular feature should be most useful on complicated departures, at cruise, and for minimums.

The last two digits in the hundreds of feet marker are combined into 10 ft. increments for sensitivity dampening. All subsequent digits should be actuated on the centenary cog principle (the same as a car speedometer) so that the number is immobile when above the even 1,000 ft. altitudes—a present fault of the new drum altimeter.

There is no necessity for interpolation by the pilot.

I believe this represents the kind of simplicity that today's complex flight procedures make mandatory.

MAJ. JOHN J. McELROY
1611 OPRON (MATS)
McGuire AFB, N. J.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Re: "Crash of Electra May Accelerate Studies to Improve Pilot Display," AW Feb. 16, p. 37. We have read your article with interest.

A question immediately comes to mind in looking at even the supposedly better altimeter which could be misread to 1,000 ft., that perhaps a second display should be available when an aircraft has descended to below 1,000 ft. altitude.

For example, if these instruments are illuminated, a relatively simple barometric pressure switch could switch the lighting from the altimeter reading above 1,000 ft. to that reading below 1,000 ft.

By so doing, a larger altimeter could be included more accurately calibrated.

For example, our company manufactures a relatively inexpensive barometric pressure switch which would be accurate to within plus or minus 100 ft. if set at 1,000 ft. to switch the illumination.

This thought seems rather obvious and, of course, may have already been considered. However, we thought it might be well to mention this point because sometimes even the most obvious ideas are missed.

A. H. MORGAN
Mgr., Sales Engineering
Aircraft Controls Co. Division
Gorn Electric Co., Inc.
Stamford, Conn.

The recent commentary on aircraft altimeters as a result of the Electra accident has an element of (tragic) fallacy about it—perhaps apparent to everyone, by now.

In their desire to eliminate the 10,000 ft. reading error in the old three-handed altimeter it appears that the engineers have introduced a 1,000 ft. misreading possibility (not to mention the confusion inherent in that nest of numbers on the right side of the drum-pointer altimeter) in the new.

That the old three-hander can be misread, I have no doubt. It's happened to many of us. But when you stop and think about it, the possibility of a 10,000 ft. misreading is more real than apparent when it comes to an instrument landing approach—how many airports are there above 10,000 ft. elevation? Now, a 1,000 ft. error with the newer altimeter is something else.

May I suggest that what is needed is a mechanism which will hold the 10,000 ft. and 1,000 ft. pointers (or indication) steady on their appropriate numbers—so as not to permit any "in-between" indications—until the hundreds hand has actually passed through zero, going up or descending (except below 1,000 ft.).

CHARLES KONIGSBERG
Captain, USAF
Woodrow Wilson School
Princeton University
Princeton, N. J.

F. S. Kudos! on your editorial "Rewards and Responsibility."

Business Interest

The ALPA and the individual pilots should give serious consideration to the editorial in the Feb. 16 issue. I wonder, however, if your criticism of their outside business interests is not a bit unfair. You suggest that they should be salesmen for the airlines and have an appreciation for the problems of management. These faculties they will not develop by poring over NOTAMS and charts or in the cockpit. And, how else are they to secure themselves against the ever present possibility of not being able to pass the physical?

Considerable judgment is necessary, of course, if the business interest is not to interfere with the proper conduct of the flying job. A pilot cannot afford to take his business worries into the cockpit with him. But I think a certain amount of business interest is, in fact, a healthy thing and a good indication of a well rounded individual—the type of man we need "up front."

B. V. DELTOUR
Northridge, Calif.

P.S. And I'm not an airline pilot. Biggest thing I've ever flown is a Bonanza.

Timely Message

I have just finished reading your editorial, "Rewards and Responsibility" (AW Feb. 16). This letter is to congratulate you on the splendid and timely message contained in the article.

I have been a steady reader of AVIATION WEEK since my active flying days terminated after the war in 1945. The magazine provides my one up-to-date link with aviation, and I enjoy it thoroughly.

Recently, I completed a round trip to Honolulu via air, and flights throughout the Hawaiian Islands on the local service offered there.

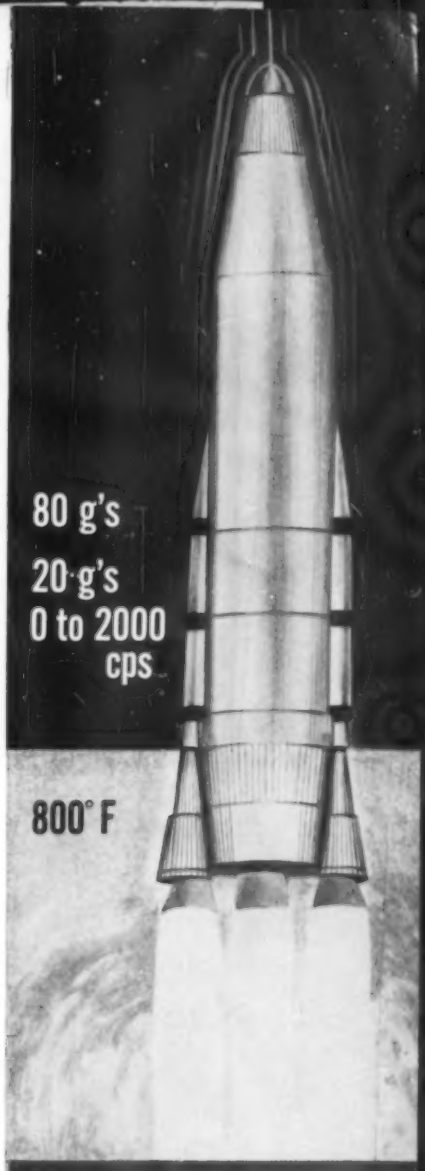
While none of these flights involved jets, I made it a point, as usual, to talk to pilots and observe operations.

I am in full accord with the points you make in your article, and hope that you will pursue this thinking so that our airline aviators remain on a truly professional basis, and do not tend to become "prima donnas."

DON MCAUSLAND, PRESIDENT
McAusland Realty, Inc.
Bellevue, Wash.

cppc Progress Report:

ENVIRONMENT



Shock . . . . . 80 g's

& Vibration . . . . . 20 g's 0 to 2000 cps

Special synchros have been designed at Clifton Precision to meet shock requirements as high as 80 g's. Vibration requirements involving 0 to 2000 cps and 20 g's have also been met. Clifton's versatility in the design of brushes and slip rings has permitted us to meet very exacting customer specifications. Let us know your requirements!

Temperature . . . . . 800° F

A year and a half ago we announced our synchros for direct turbo jet engine mounting which successfully resist 450° F. Since then we have progressed to where we are developing synchros that withstand 800° F for short periods and retain their precision characteristics.

Our high temperature resistant line of synchros can now be obtained in sizes 8, 10 and 11. High temperature units also available in our servo motors, motor generators and precision computing resolvers.

SIZE 8 SYNCHRO
ACTUAL SIZE

Radioactivity . . . . . 1 Kilocurie for 2 weeks

We recently delivered radioactivity resistant synchros to a manufacturer of radioactive material handling equipment. When tested, these synchros successfully resisted unremitted radiation from 1 Kilocurie of Cobalt 60 for 2 weeks. The synchros remained functional in all respects i.e. accuracy, nulls, lubrication, insulation unimpaired.

For information call or write: Sales Department, 9014 West Chester Pike, Upper Darby, Pa. (Suburban Philadelphia.) HIlltop 9-1200 or our Representatives.

LOOK TO CPPC for ANY ROTARY COMPONENT

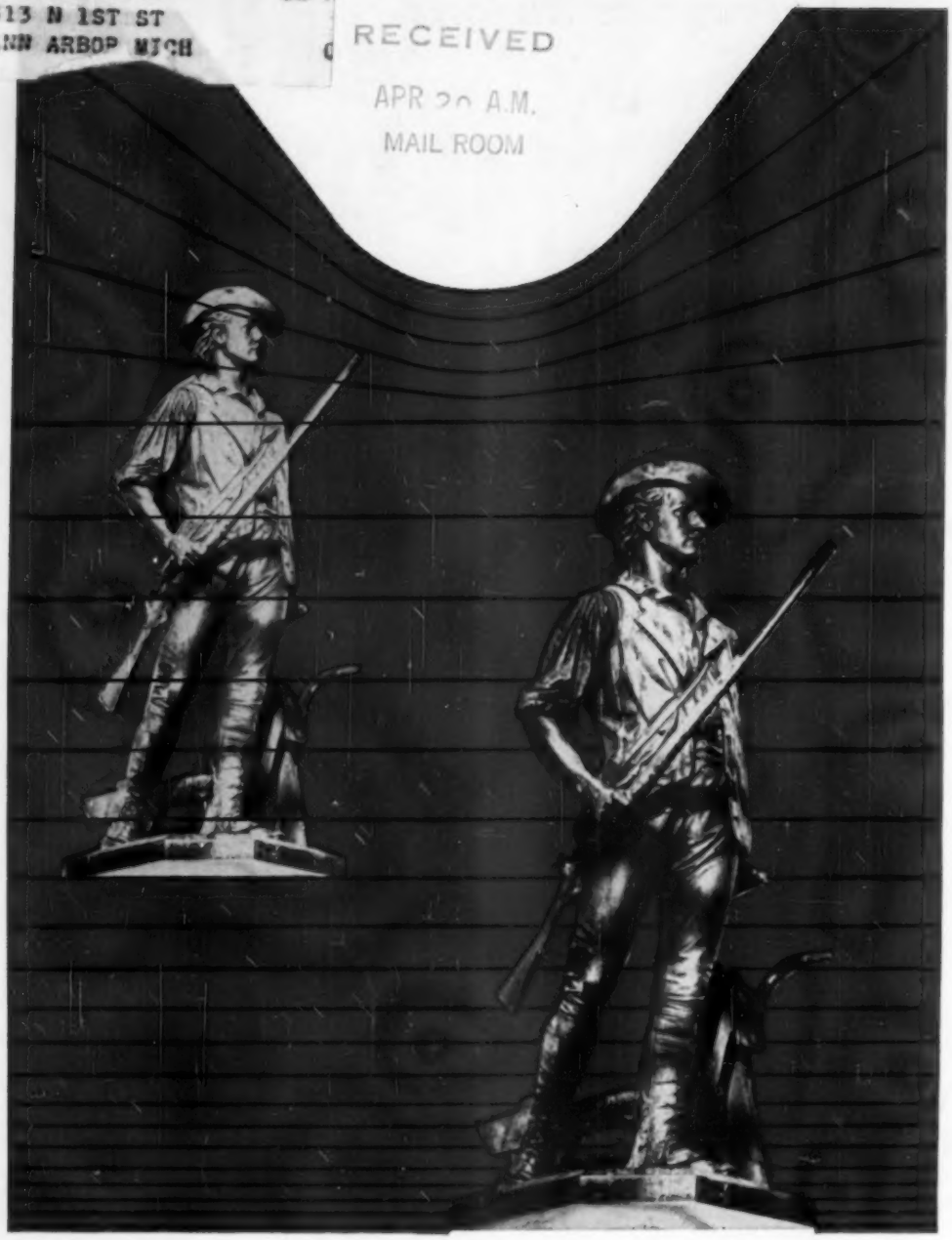
cppc

CLIFTON PRECISION PRODUCTS CO., INC.
CLIFTON HEIGHTS, PA.

ENGINEERS—Do you want rapid growth as an "extra" in your career?
Write David D. Brown, Personnel Director, Dept. A4

UNIVERSITY MICROFILM INC
STEVENS RICE GS #
313 N 1ST ST
ANN ARBOR MICH C

RECEIVED
APR 20 A.M.
MAIL ROOM



Avco and a Modern Minuteman—Recent work at Avco led to a solution of the missile reentry problem, and to production of the nose cone for the Air Force Titan ICBM. Now the Air Force announces a development program for Minuteman, a solid fuel missile that will be capable of instantaneous firing with no preparatory fueling delays. Its nose cone, too, will come from Avco's Research and Advanced Development and Lycoming Divisions . . . implementing this modern Minuteman's vigilant defense of our shores.

UNUSUAL CAREER OPPORTUNITIES FOR QUALIFIED SCIENTISTS AND ENGINEERS . . . WRITE AVCO TODAY.

Avco

AVCO MAKES THINGS BETTER FOR AMERICA / AVCO CORPORATION / 750 THIRD AVENUE, NEW YORK 17, N.Y.